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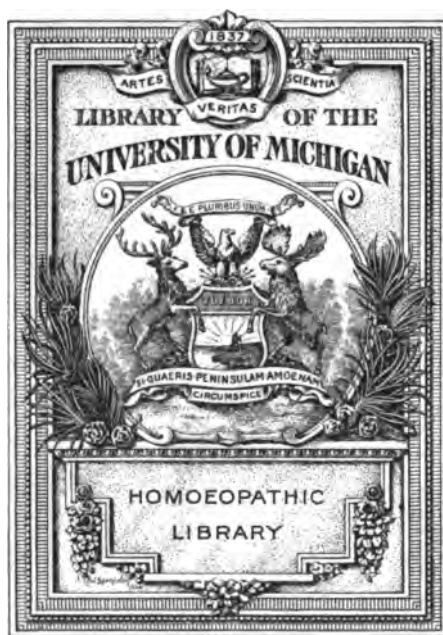
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**HIGH FREQUENCY
ELECTRIC CURRENTS IN MEDICINE
AND DENTISTRY**

THE author is one of the most illustrious teachers of electro-therapeutics in America.

—Medical Sentinel.

FROM such a practical observer and teacher as Dr. Monell one must accept his results as from one qualified to dictate.

—Canada Medical Record.

DR. MONELL is regarded as one of the foremost thinkers of the medical world, and in electro-therapeutics has done more for static electricity than any other living man. His voluminous writings have made for him a living history. His books on the uses of electric currents in X-Ray work and in electro-therapeutics have had an enormous sale. As author, teacher, scholar, he is at the top.

—The American X-Ray Journal.

WHEN PROFESSOR MONELL issued his work upon static electricity, it was taken up by the medical profession as few books upon electro-therapeutics have been, and almost from the day of issue became the work of reliable reference with not only multitudes of general practitioners, but also with the specialists in this line of medicine, and especially with the medical teachers of America. When the announcement was made some weeks ago that a general work upon the entire subject of electricity in medicine was in process of preparation by Dr. MONELL, a stir of interest passed over the profession, and the mere announcement that the work has now been published will bring for it a very large sale. The work stands forth as one of the most striking medical productions of 1897.

—Medical Sentinel.

HIGH FREQUENCY ELECTRIC CURRENTS IN MEDICINE AND DENTISTRY

THEIR NATURE AND ACTIONS AND SIMPLIFIED USES
IN EXTERNAL TREATMENTS

BY

S. H. MONELL, M.D.

NEW YORK

Professor of Static Electricity, International Correspondence Schools, 1898-1903; Founder and Chief Instructor, New York School of Special Electro-Therapeutics, 1896-1902; Member of New York Academy of Medicine, 1895-1900; Editor of "Journal of Treatment," 1904-1905; Author of "A Pictorial System of Instruction for Physicians in X-Ray Methods and Medical Uses of Light, Hot-Air, Vibration and High Frequency Currents," "Manual of Static Electricity in X-Ray and Therapeutic Uses," "Treatment of Disease by Electric Currents," "Elements of Correct Technique in Electro-Therapeutics," "Electricity in Health and Disease," "Rudiments of Modern Medical Electricity," "The Cure of Writers' Cramp," "The Modern Light Bath and Some of its Modifications," etc., etc.

*FINELY ILLUSTRATED WITH SPECIAL
INSTRUCTION PLATES*

NEW YORK
WILLIAM R. JENKINS COMPANY
851-853 SIXTH AVENUE
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1910

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P R E F A C E

IN a plain and conservative way this book will aim to show physicians and dentists what they can now readily *do* with high frequency currents of electricity.

Their value in many acute and chronic conditions which are common in medical practice has become so marked that mere acquaintance with the results obtained by others should prompt a desire to employ them by all who read of their work.

Improvements in apparatus have increased their efficiency and simplified their administration since the author's pictorial text-book published in 1902. Those who put high frequency currents to the test of personal use will be convinced of their therapeutic actions.

If the equivalent of this great pain reliever, antiseptic, and promoter of metabolism, had been a new serum, or anti-toxin, or some psychic fad half pseudo-science and half quack religion, the fame of it would have swept around the world in three months. But this remedy—more far-reaching for good than exploited catarrh and cough cures, and vaunted "vegetable compounds," and all the combined "best sellers" of patent medicine factories, in which the American Public invests some hundred million dollars and twenty per cent of its health per year—happens to be only one phase of an electric current, modest, reticent and conservative, the study of skilled men, the subject of a decade of scientific investigation; and so it has patiently crept into quiet recognition during the past ten years, tested by progressive physicians here and there, and more in Europe than here, yet never losing ground once made, ever gaining increased confidence, and now slowly coming into its own.

THE AUTHOR.

NEW YORK, 1910.

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A Fable

Dedicated to his Colleagues

By the Author

A GREAT Musician, wandering in the Forest with his \$10,000.00 Violin, fell Fast Asleep beneath a Tree, and the Animals gathered in discussion. One said, "What is the Box the Man has?" "It is a *Mystery*," said Another. "No one Knows What it is; It is *Very Mysterious!*" said they all.

"It is a New Discovery," remarked the Ostrich. "I was the First to See it," said the Lynx-Eyed Lynx. "I was the First to Describe it!" cried the Giraffe. "I Mentioned it First"—"I Improved it"—"I Modified it"—"I Invented the Wood of Which it is Made"—"I Devised the Hole in the Handle"—Shouted the Quartette of Claimers with one Voice.

"The Method of Making it Go Originated with Me!" Clamored the Camel. "Not So," said the Learned Fox; "I had been Using it a Half-Hour before you came." "It is in its *Infancy*," said the Cautious Turtle, "and Should be Thoroughly Investigated." "I long ago Abandoned It," said the Sacred Ox. "And I," repeated the Roebuck; "And I," echoed the Buffalo; "And I," Chimed the Chorus of Independent Scientists in the Back Seats.

"It is a *Music Box*," spoke the Conservative Owl who was Up a Tree. "What Will it Play?" asked the Lion. "A Whole Lot," answered the Owl, who had Traveled and heard Paganini and Ole Bull.

"I Do Not Believe It," said the Animal from Alice's Wonderland. "It is entirely Empty, it Cannot Make a Sound," said One who stepped Close and Looked into It; while another gave the Box a Knock and Confirmed his Colleague's report.

"Let us Try it," said the Kangaroo, whose wits had been Remarkably Sharpened. "Yes! Let Us Try It," said they All; but on Reflection the Conservative said, "We do not Accept it as a Universal Orchestra: it Has not been *Scientifically* Demonstrated as Yet."

At length Several Extremists, noted for Pursuit of the New, exclaimed with Enthusiasm, "We have No prejudice Against Scientific Music; Let Us Try it!"

So the Moo-Cow rubbed the Strings of the Violin with her Nose, and they Moaned; the Elephant drew his Trunk across the Strings and they Groaned; the Hippopotamus Gently Stroked them with Her Tail, and they Wailed; and at the Scratch of the Leopard's Claws they gave a Sharp little High-Pitched Cry.

The Koodoo Africanus swept a Triumphant Glance around: "I Told You So! this

is Not a Universal Piano Player, it will Not play *Everything!*"

"It Evidently has its *Limitations*; it is Not an Orchestrion," declared the Close Observer who had Watched the Proceedings with Professional Distrust of the Exaggerated Claims Being Made on Every Hand. Taking this Cue, "It is Obviously a Quack Thing!" called the Owl from the Top of the Tree.

"I do not Regard it as a Giasticutus," uttered the Deprecatory Voice of a Critic, and All Agreed that its Value was Greatly Overestimated by Enthusiasts. "As it will not play Every Tune we Cannot Unqualifiedly Endorse it as an Unfailing Harmonicum," was the Sage Verdict of the Wise in the Convention.

"I would Not Advise its Use," spoke the Emu looking on at the Conclave. "Nor I," said Another; "Nor I," vouchsafed a Third.

Thus it was Demonstrated by the Most Scientific Tests (and was the Consensus of Scientific Opinion among the Leading Animals, especially Among the Older and Superior Heads) that "the Alleged Orchestra (or So-called Universal Music Machine) while Admittedly Suggestive, and Possibly Able to Render Certain Tunes Through the Agency of Suggestion, is not yet Thoroughly Understood and its Employment is

not Recommended. The Few Sounds it can make are such only with Respect to a few Notes, and these of No Great Consequence or Significance."

This Preliminary Report was therefore Submitted to the Convention by the Committee of Investigation and Approved and Carried.

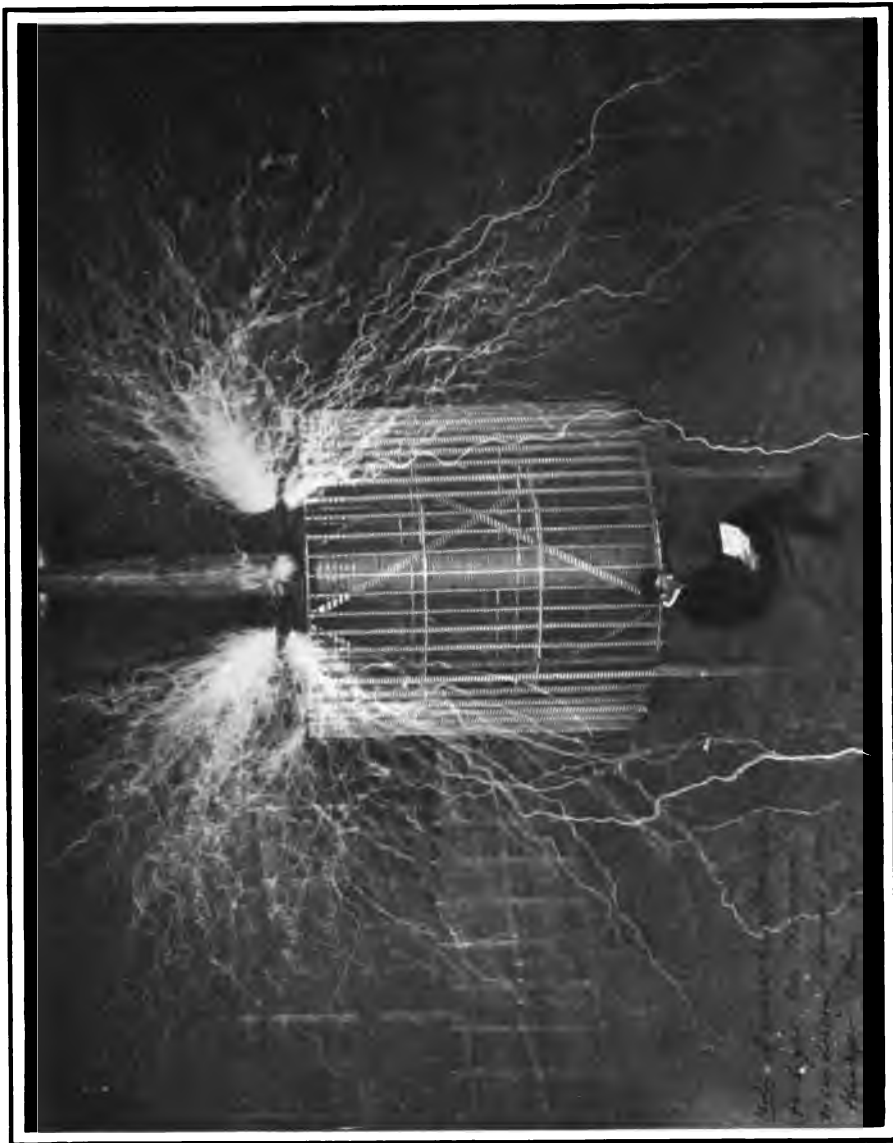
Whereupon the G. M. awoke, much refreshed, took his Stradivarius under his arm, and that evening at the opera house entranced an immense audience by his interpretations of Beethoven, Mendelssohn and Liszt.



The Application of this Fable
Will be found in the Book.

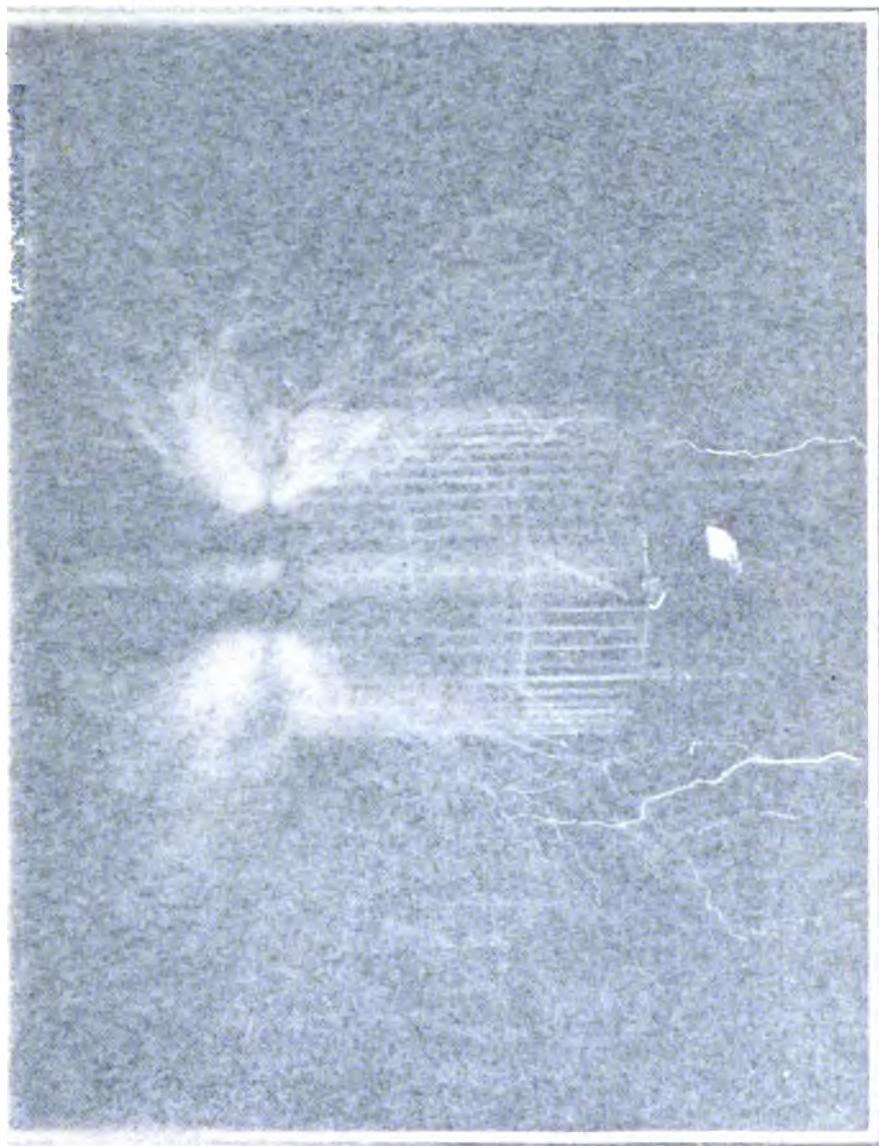
PART I

**The General Consideration of
Electric Currents of
High Frequencies and High Potentials
And the Instruments and Actions
Which Make Up the Sum of Their
Medical Usefulness**



FRONTISPIECE.—Illustrating an experiment with a magnifying transmitter in an electrical laboratory. A high frequency current sufficient to light two thousand incandescent lamps passes through the air, yet the inventor reads safely by the solenoid. This picture is presented (in contrast with others in this book) to illustrate the extensive and beautiful scope of high frequency discharges and apparatus—from outbursts of streamers flashing many feet through space, to rippling rivulets of sparklets with the touch of a floating feather on the skin; from great transformers of central power stations to the miniature compactness of the pocket instrument in Plate XV. No other phase of current is so fascinating to the student of electrical sciences. This book will demonstrate its medical side.

(continued)



Plasma instabilities in a vacuum tube with a magnetic field. The setup is in the laboratory of the University of California, San Diego. The setup consists of a vacuum tube containing a plasma, with a magnetic field applied. The plasma is heated by a radio-frequency current. The setup is used to study the growth of instabilities in the plasma. The oscilloscope on the left shows the signal from the plasma, and the control panel on the right is used to adjust the parameters of the experiment.

CHAPTER I

THE FIFTH MEDICAL CURRENT

What it is. Tesla. The Accepted Definition of Electricity. Facts in Plain Terms.

WHEN Volta finished Galvani's work¹ he had contrived a means of generating an electric current which passed around a conducting circuit in one direction without *breaks* and without oscillating back and forth between the poles.

Faraday developed the next step when he originated the induction coil and produced a means of transforming the "constant" current of Volta and Galvani into a broken current of higher pressure which traversed its conductors in a series of "interrupted" jumps. Ruhmkorff greatly improved the Faradic coil. Then came dynamos.

When street lighting by electricity was introduced a generation ago the currents employed, and the only commercial currents known, shot through their circuits like streaks of searing flame, so "heavy" in quantity that a live wire would destroy life almost as quickly as a stroke of lightning. They were "dangerous" currents, and workmen touched them carefully, or were careless at their imminent risk.

On a memorable night in May, 1891, Nikola Tesla, the *Slav*, young and enthusiastic, with a poet's mind and the aspirations of genius, stood before the American Institute of Electrical Engineers and lighted lamps with currents passing harmlessly through his own body and heated wires to incandescence by the touch of his conducting hand.

¹ Galvani died in 1798, Volta in 1827, and Ampere in 1836. The immortal Faraday, "the greatest experimental philosopher that ever lived" did his chief work from 1825 to 1850.

With smiling countenance and without physical sensation he placed himself in circuits that by all the laws of alternating or continuous currents should have brought the lecture to a close by the death of the daring lecturer. Yet he went sweeping on, astonishing his audience by demonstration after demonstration of unfamiliar discharges, new-born into electrical science and christened with the name "High Frequency." That lecture sent the fame of Tesla round the world.

It was the beginning of the wireless wonders of telegraphy and telephony, and the flight of harnessed motor power through the air. And it also created a new weapon for the healing art which has overturned the traditions of Galvani, Faraday, and Duchenne.

Now, what was it that Tesla had done to the ordinary "heavy" current that robbed it of danger and produced its extraordinary characteristics? In the simplest words, he had practically *nebulized* it with a transforming *atomizer*, diffused the heavy stream of current into a discharge of *mist*, transformed the thick flow of low-voltage current into a myriad of minute particles of tremendously high voltage, imparted to the primary low-pressure volume of the street mains the penetrating velocities of hails of miniature Mauser bullets. These alterations in the character of the commercial current made possible its new actions.

In transforming the primary current into high-frequency discharges Tesla took from it some of its former properties. For instance, it lost its *electrolytic* energy, it would no longer exert the same power through the same motor, it ceased to sear and burn in its track, and contact with it no longer struck the muscles with a paralyzing and deadly shock.

To comprehend the change is to grasp the explanation of the effects. We can fancy a man beneath a falling cliff, crushed by the mass and stunned to instant death. But if, by an ingenious device, the mass in falling becomes finely pulverized and drifts down upon the man in a cloud of dust,

we can imagine that he will still stand erect and can move in and out of the cloud harmlessly.

Over Niagara pours a mass of water that strikes the rocks below with staggering force, but up from the falls floats an ascending mist of the same water, now transformed so exquisitely that it will not crush a flower.

In effect, and according to the different nature of electricity, Tesla made a somewhat analogous transformation in the relations of the elementary component phenomena of the current he employed. With its greatly multiplied pressure raised from 110 volts to hundreds of thousands, it easily broke the bonds of ordinary insulators, moved on open circuit, and discharged from a single pole.

With particles now infinitely smaller than our blood-corpuscles or the pores of the skin, it passed through the body as sunbeams pour through a keyhole, not stopping anywhere long enough to set up ordinary sensation or stimulate any muscle-fibre to contract.

But the gentlest dew feeds plants with moisture and grass grows rank in fogs as well as in rain. A mist will saturate the leaves of flowers and furnish drink to thirsty soil; and this nebulous, all-penetrating, tremendously energetic but marvelously gentle high-frequency current will saturate the human tissues from head to foot and feed them with potential vitality from which a new increase of physiological nourishment is derived.

With apologies to the late Lord Kelvin and others for ignoring strict technical terminology in this description, the foregoing rough sketch of our remedial agent will start us on our way.

Electricity is a form of the energy of molecular motion which conventional usage has considered as moving in a "current." There is but one *electricity*, but there are various ways of exciting electrical phenomena—by friction, heat, chemical and mechanical force—and different ways of establishing the physical state of electricity when it is generated for a particular use.

Each given "current" is subject to infinite variations in the relation of density of volume to degree of pressure (electro-motive-force), and also in the relation of these two factors to a "resistance" in the circuit. Every current is the creature of controlled volume, voltage, and resistance. Electricity is not alone in this respect. In all fluid forms of matter flowing as currents to perform their work the same principle applies, as in *water-power* the physical state of the water-current is created and controlled by the relation of its *volume* to *pressure* at its head, and by the *resistance* to the flow which the pressure behind it must overcome. These three factors exerted on a chunk of steel can alter it from a useless lump to a bar, a tool, or a strand of tempered wire, coarse as a cable or fine as the finest hair.

Exerted upon water, these controlling factors can start a water-current from the placid body of a lake, hurry it along a river channel with an increasing fall, quicken it to rapids by a slanting drop, drive it with force through the resistance of a narrowed gorge, plunge it over a cascade, and by the impact of high pressure upon abrupt resistance at the rocky foot see the once unbroken current of low pressure and large volume near the lake now transformed into flying particles of high-pressure-force, with density of volume almost lost in a mist—from which it can again condense back into its original body.

The career of a medical current of electricity carried through such a course has the primary cell for its lake of origin, the galvanic current for its low-pressure flow of unbroken density of volume, the faradic current for its more rapid rush of the broken rapids, and the *high-frequency*, high-potential current for its last transformation, when the strain of tension breaks down the cohesion of the particles and they fly into a diffused and oscillating state.

The mechanical devices which regulate amperage, voltage, interruption, and resistance, in medical currents of electricity, have now added to these common and fundamental factors of *dosage* the fifth and revolutionary factor of "fre-

quency." And it is this new factor acting with certain others which lends to this newer phase of electricity the properties which enable the physician to use it in ways that supplement the actions of galvanic and faradic currents, and to obtain certain therapeutic results which were unknown to the primitive induction coil and the chemical cell.

This word *frequency* is a distinctly modern term. The galvanic current does not alternate between the positive and negative poles, and hence has no "frequency." The term is not applied to faradic currents at all. They are "interrupted" currents which are relatively low in the scale of volume, voltage, and number of breaks per second. The alternating street current for light and power is usually a 104-volt, 60-cycle current, oscillating only 120 times per second, and this low rate does not call for distinctive consideration.

But when alternations rise above 10,000 per second and voltage mounts beyond the hundreds of thousands, these twin features put such currents into a class by themselves and they are called "currents of high frequency and high potential."

They can be made to attain a voltage above a million and a frequency above fifty billions per second, but with these extremes their medical actions diminish and in practical use the physician mainly employs a range of E. M. F. from 5,000 to 500,000 and frequencies between 200,000 and ten million. The greater part of medical treatment is probably done at this time with medium frequencies under two million.

Treatment with this agent presents one novel feature not formerly employed with any other medical current; namely, the administration through a Geissler vacuum tube electrode. The glass and the vacuum act as a "resistance" which, inserted at the end of metallic conduction, acts upon the current something as the resistance of the small outlet against which a vigorous pressure drives the fluid from the bottle of an atomizer—it *atomizes* it. It turns the denser

current into a spray discharge. But methods of application belong to another chapter, and we must now discuss the *definition* of electricity.

It has long been the plaint of the scornful that "we do not know what electricity *is*," and there has been a demand from such that we should have a definition in set words—as, a cane is a stick; or, a quart is two pints—before their confidence could be asked by this agent. So long as its nature was "mysterious," and "not thoroughly understood," could any scientific physician prescribe an electric current? Meta-amidophenylparamethoxychinolin (dose 4 gr.) is all right, but *electricity*!—"Not until we know what it is," say the wise.

The author is certain that this mental attitude of the heedless—not knowing what they would do with a definition if they had it—has nurtured more prejudice against a noble remedy than even the quackish faradic batteries of cheap price—sold mostly, not to real "quacks," but to physicians and the general public. Half the medical profession has hitherto dismissed the subject of medical electricity with the condemnatory remark, "No one knows what it is." The finality of this barrier is assumed to close discussion. Nobody can get over it: there is nothing left to say.

Lay writers also notice the need of a definition. A recent example is found in the great 12 x 16 journal which claims "five million readers." In an article on "Telepathy," the author of which appears to swallow its wildest fancies, he opens his story with this:

"Do you know what electricity is?" asked a visiting member of the Board of Education. "I did," the boy answered, "but I've forgotten."

"What a pity!" said the examiner: "The only person in the world who ever knew. We do not know what electricity is and probably never shall."

But fortunately the practical workers in electrical fields have not been deterred nor dismayed by the omission of past dictionaries. Nor is it clear just what the man in the street

would do with a definition if he had it. Every cow eats grass, but one of the most lauded of American poets placed these two lines in the chief product of his pen:

"A child said, '*What is the grass?*' fetching it to me with full hands.

"How could I answer the child? I do not know what it is any more than he."

We shall present the modern accepted definition of electricity in a moment, but first take heat—common, familiar *heat*. The Century Dictionary defines heat as "the energy of molecular motion." It seems *plain*, but let a stranger from the north pole who has never felt heat enough to know it, take this definition home with him—what help would he get out of it? Could he search anywhere around him and identify the "energy of molecular motion" close enough to tell his wife what to use it for? What help is the definition of heat to the cook? or to the blacksmith? or to *us*?

The fact is that in doing the world's work we use the tools at hand first, and scholars sit down and define them afterwards. It may be doubted to-day if one in a thousand of the highly educated surgeons who daily use a steel knife knows what iron ore is, or can define it. We have lately read that *no one* knows. If that is true, the innumerable millions of tools made out of iron ore and used without a definition make the alleged need of a definition of electricity ridiculous. The main thing is the *use*.

Nevertheless, here follows the scientific information that physicians have been asking for, and the perusal of it should leave no further scientific objection to the employment of electric currents in medical practice.

It is now, since the enunciation of the *electron theory* some years ago, the conception of science that electricity consists of *electrons*, the electron corpuscle being the structural unit of all the phenomena of matter and energy, the smallest entity in existence, complete in itself.

The corpuscle electrons repel each other, but form *alliances*, and when they unite in groups of from 800 electrons

up to 200,000, these groups constitute the *atoms* of the various chemical elements, seventy-odd in all, which make up the known forms of matter. The number of electrons in a given group (the 800 group is the hydrogen atom) determines its physical and chemical properties and its atomic weight, through all the solids, fluids and gases of the material world.

These units (each one being a corpuscle of negative electricity) are held in the harmonious relations of their atomic grouping by the attracting force of positive electricity; for, just as every magnet and each part of a magnet down to the smallest, has a north and south pole and *every stick two ends*, so every electrical charge has two signs—*positive* and *negative*. The attractions and repulsions of the positive and negative signs are the essence of electronic phenomena in all their manifestations.

This double property of electrons makes them sources of matter and sources of force as well, the dissociation of stable forms of matter furnishing the intra-atomic energy of the unstable forms of matter which we call heat, light, electricity, etc.

Science now deems that manifestations of what we call *energy* are vibrating waves discharged from electrons acting individually or in collected units. These waves propagate with different lengths, swiftness, frequency, etc., ranging all the way from the infinitely limited motion of the electrons composing the densest of solid metals up to the nearly 2-quadrillion vibrations per second of the highest ascertained ray of light. It is the constant dance of substance, for inert matter does not exist.

Therefore, according to the most advanced thinkers of present-day science, the primitive world-forming unit is the electron, and *electricity* itself (in particular) *is the specific form of the agitation of electrons which manifests itself in electrical phenomena—attraction and repulsion, chemical decomposition, magnetism, heat, light, etc.—and measured by the total kinetic energy of such agitation.*

A dominant law of the universe and of existence is nature's law of the conservation of energy, and the conversion of energy from one manifestation to another for different kinds of work. Energy is of the molecules of matter—their moving agitations or their power to move. There is no other working force in the world. Created matter exhibits the varied phenomena of work solely because in the process of creation its molecules were charged with the energy expended in creating them; and ever since, energy held absorbed in potential form or liberated and made kinetic, has maintained in continuous evolution the handiwork of the Creator.

"Potential energy" is molecular agitation condensed for renewed expenditure and stored in a locked-up state. All matter is charged with it. Kinetic energy is the charge of a given mass of matter released by the action of other energy upon it, liberating its molecules and permitting their active movement. This liberated energy then performs work which we can identify by the phenomena made manifest to our senses in the results of the work done. The results are accomplished by molecules organized into armies and exerting kinetic energy in unison to a common end.

We can neither see molecules nor their movements. We have no way of saying to Nature that she may send us a dollar's worth of *whirling* molecules, or fifty cents' worth of molecules flying straight ahead, or agitating themselves in any other fashion. We ignore the *form* of molecular motion altogether and deal simply with its manifested results. These we recognize and identify by name.

Heat is "the specific form of kinetic energy of molecular agitation which produces the phenomena of heat," hence we call it heat energy. For similar reasons we call other certain forms of molecular movement chemical energy, and still others mechanical energy; distinguishing them by gross phenomena independent of agitations behind the curtain of our senses. On exactly the same grounds we apply the name "electrical energy" to molecular agitations which

produce the phenomena that we have identified with the actions of electricity in the performance of work. Potential energy is the bent bow, and whether the flying arrows of released molecules rush to the production of thermic, chemic, mechanic, or electric, forms of kinetic energy is a matter only of the specific character of the molecular movement.

Science therefore places electrical energy in no different relation to the "kinetic energy of molecular agitation" from which arise all the physical phenomena of the universe. Heat, light, electricity, chemical action, mechanical force,—it is all a matter of specific movements, agitations, waves, of specific molecules, or the elementary units of which molecules are made. We do not *create* energy or *generate* motion; we convert the existing *status potentialis* into the state kinetic, or we convert kinetic energy of one form into another form to better adapt it to our uses. The basic principles are very plainly illustrated in any large manufacturing establishment.

A number of persons whose scientific attainments enable them to read a newspaper and absorb the wisdom of Sunday Edition Symposiums on wonderful things are wont to stigmatize electricity as "mysterious," and as a claim to credit and proof of their own superiority, they assert that "*they* do not believe in it." "They" thus besmirch its character and place it in the list of those who are no better than they should be. This is keeping electricity back. But in the light of nature's physical laws it possesses the same mystery as fire, water, wind, acid, alkali, friction, cold, grass, atmospheric pressure, or a beefsteak; but no more.

On this point there comes forward Dr. Gustave Le Bon,¹ of whom a learned writer says: "There can be no question that Dr. Le Bon's experiments are authoritative and conclusive. He has won a high place in scientific circles. He has been at work on them for ten years, and was the first to an-

¹ Member of the Academy of Science, Belgium; author of "Evolution of Matter"; "Evolution of Forces," etc.

nounce to the scientific world many of his discoveries. His past reputation ensures his work and guarantees its genuineness and care. Further, Dr. Le Bon clearly shows us how his results were brought to pass. The *facts* are established beyond question."

The part of the *facts* set forth by this eminent leader of scientific research of immediate interest to us here is contained in the following paragraphs from Le Bon's report of his ten years' work and his conclusions:

"Matter, formerly regarded as inert and only able to give back the energy originally supplied to it, is, on the other hand, a colossal reservoir of energy—intra-atomic energy—which it can expend without borrowing anything from without.

"It is from the intra-atomic energy manifested through the dissociation of matter that most of the forces at work in the universe are derived, and notably electricity and solar heat.

"Force and matter are but two different forms of one and the same thing. Matter represents a stable form of inter-atomic energy. Heat, light, electricity, etc., represent unstable forms of it.

"By the dissociation of atoms—that is to say, by the dematerialization of matter—the stable form of energy is simply changed into those unstable forms known by the names of electricity, light, heat, etc."

The authority from whom we cite adds: "Of course Dr. Le Bon is not alone in this. Several other English, American and European scientists have advanced the same ideas, but it is only recently that they have won acceptance in the scientific world."

It is the expectation of men who have lived through the development of instruments of refinement which commenced with the first galvanometer of the late great genius, Lord Kelvin, that still further advance in delicacy of research and yet undiscovered apparatus will, in due time, determine the exact electrical conditions of physiologic activity in man,

and will enable us to command and apply to the diseased organism the precise administration of electrical energy required by nature to restore to normal the *physiologic balance* of the cellular functions, the particular *unbalancing* of which is manifesting itself as a *disease*.

The past forty years have taken us far in this direction—much farther than the non-posted reader suspects—and we need not neglect the potent resources of the present while waiting for the revelations of the coming twenty years.

The crying need of the medical profession is a great teaching institution where, under ethical auspices and competent men, the enquiring physician can witness the best work of the best methods of all the best therapeutic apparatus, under the guidance of the best hand—and with *commercialism suppressed*.

We have the Rockefeller Institute for Medical Research, we have the American Medical Association, we have the Academy of Medicine, we have abundant medical colleges and journals, and many specialists who display great skill in highly cultivated though narrow fields; and we have manufacturers of instruments and means of utilizing physical agents who are the equal in ability of any in Europe. But where can the student (or critic) of modern methods see them employed collectively—in one city, under one roof, with the technical accuracy of experts and with facilities for comparative study of means, measures, actions and results? Not anywhere in Christendom—*yet*.

But the need of such a place is obvious to the closed eyes of blindness itself, and we have advocated it for years. It would serve two purposes. It would satisfy the search for knowledge on the part of those who earnestly seek to give their patients the best skill they can possess: and it should put a quietus on the tendency of conservatism to reject these physical agents without seeing their work.

Once supply an authoritative demonstration of these great medical agencies and open it to all, and skepticism would stand dumb. Against the facts of daily scientific demon-

strations which the profession could witness, the man who would still set his futile prejudice would expose himself to the charge of betraying his own patients.

But seeing is believing, and what we witness over and over again we cannot doubt. Nay, with our hands we can learn to do the same things and give our own patients the benefit. The idea and scope of it is *great*. We cherish it with affection. As the vision of the resplendent structure rises before our therapeutic eye we love to dwell upon its noble possibilities, its sun-like centre from which would radiate the blessings of these greater remedies to mankind, of comforts spread abroad, of mercies scattered, of lengthened lives and fuller usefulness to myriads of men and women now borne down by the weight of burdens that drugs do not lighten and that surgery does not help.

Such an edifice in New York would be a medical palace of Aladdin—the stately dome of Kubla Khan come true: the unfinished window in the tower completed, the work of modern science surpassing the wonders of the old magician; the building permanent, equipped as we picture in our lingering fancy, and endowed and dedicated to medicine and mankind.

How the realization of that therapeutic dream would thrill Hippocrates and make the immortal Sydenham burn with the ardor of the great clinician! It is not impossible and it *may yet come*.

When it comes, electricity will stand revealed to patients and physicians alike, as the most variously helpful and faithful servant ever heaven-sent to earth to be the hand-maiden of the healing art. The larger possibilities of the high frequency currents especially, in such a building and with revolutionary apparatus, can be made to astonish the profession of to-day as the demonstration of Harvey startled the Age of James.

CHAPTER II

LIFE PHENOMENA AND ELECTRICITY

The Key to an Understanding of Applied Electricity in Disease. Showing how Nature Enables Her Own Great Physical Agents to become Great Physiologic Remedies in Medical Treatment. Internal Currents of the Body. The Elementary Tissues. Cells and Their Powers. The Energy of Living Material. How Electrical Stimuli Aid Cellular Nutrition. The Blood and Facts About It. Nature's Defenses Against Disease and Germs. Electricity and the Nervous System. The Nature of Nerve Impulses. Reflexes. Self-Generated Currents Within the Human Organism. Ions and Their Relation to Life Phenomena.

THIS chapter begins a section of condensed physiology explaining the relation of physical remedies to the treatment of disease. Read carefully all that is set forth.

The word "physical" means, "pertaining to nature or to the body." The word "physiologic" signifies, "pertaining to the normal (natural) *functions* of the body and organs." The application of the one to the other—going on all the time in the human organism—is nature's way of keeping us alive and well. Mechanical instruments for intensifying and directing dosage and action permit us to copy nature's own means to an important and growing extent.

To enable us to follow in her footsteps with what skill we can, some knowledge of nature's internal processes is necessary, and as a key to unlock part of the problems before us we shall now point out how nature shows the way. This chapter and the two that follow constitute one of the most valuable sections of this book.

To those who acquired their school knowledge of physiology, as did the writer, twenty or more years ago, when Claude Bernard was the peerless classic of research, and Flint was the pole-star of American students, the teachings

of modern investigation come as a surprise. New interpretations of former findings follow on new discoveries as more delicate means of experimental research increase our store of facts. Electricity, once almost negligible in the writings of eminent physiologists, now holds the place of honor and sits at the head of the table.

Internal electrical stimuli of various wave lengths are known to excite not only the functions of motor nerves and to induce the contraction of muscle-fibres, but they also operate the special senses, the work of glands, and the processes of nutrition. In short, according to some authorities of the present day, the whole machinery of life's movements is electrically driven. It was once ridiculed, but now it is so plain that it is obvious that no other means of inducing motion could by any possibility be applied to the internal human mechanism. Steam or compressed air certainly could not, nor could a clock spring be wound up to advantage within the intricate organism of the body. Yet *something* must act as a motive power to maintain the ceaseless motion of living cells or they would no longer be living cells—they would be stilled in death.

The electron theory of vibrations more and more throws light upon the once dark places of physiology. It is held that different nerve centres and different cells are tuned to impressions of different wave lengths, as in wireless telegraphy a tuned receiver will respond only to a similarly tuned impulse.¹ Many years ago inductive reasoners argued that

¹ On the other hand the view is held by older physiologists that the nerve impulse is identical in character in all nerves and only varies in intensity. And the reason that in one case we get the response in *hearing*, and in another case in the sensation of *sight*, and in others the contractions of *muscles*, is to be found, not in any difference in either nerve fibres or nerve impulses, but solely in the *terminal condition*—the manner of the ending of the nerves in the tissues of different functions.

These observers point out that terminal conditions determine the discharge phenomena of a current used in treating a patient, as, for instance, a spark from a ball terminal electrode, a brush discharge from a point, etc. This view does not follow the suggestions of wireless

electricity and what they called "vital force" were identical, but for lack of modern instruments of demonstration the early physiologists rejected the idea that electricity and life had much in common. Now it is accepted that the workers of the body, the tireless energies of living matter, every cell and nerve in the breathing engine called man, sustain their marvellous toil under an electric drive.

The old aphorism that "labor is life" is expanded to disclose that electricity is the laborer which distributes the released energy of our foods, the combustion of which in the system by union with oxygen supplies the initial fuel and the heat for conversion into force—phenomena very closely analogous to the conversion of heat into force by the combustion of fuel in the steam engine and the generation of electricity by the engine-driven dynamo.

The chief English text-book on physiology opens its twenty-first edition (1908) with the declaration that:

"Physiology treats of the *functions*—the manner in which the individual parts of the body carry out the processes of life; is the application of *the laws of chemistry and physics* to life; and has a most direct and intimate bearing in its application to the scientific and successful investigation and treatment of disease."

We are content to take our stand on that platform as the *rationale* of the employment of the great physical agents—water, heat, light, vibration, electricity—as physiologic remedies in medical practice. Let us now briefly remind ourselves of certain helpful things forgotten in recent devotion to pathology—which is simply physiology gone wrong.

The elementary tissues of which the body and its organs are built up consist of four structural groups—epithelial, connective, muscular, and nervous. The supreme impor-

telegraphy as to tuned vibrations, but it may mean about the same thing in the end. Of course the differently composed arrangements of the terminations in differently functioned tissues may be tuned receivers or they may be constructed to make only one kind of response to all kinds of vibrations and be able to receive every vibration that comes their way. Nature works all right either way.

tance of the cell, the fact that cells are the living units of the organism, the growth of the body from cells, the dictum of Virchow, "every cell from a cell," intensifies our interest in the fact that *cells respond to electrical stimuli*.

The power that certain tissues possess of responding by some change to the action of an external agent—taking up the external energy and transforming it into their own energy—is called "irritability"¹ or "excitability," and this power is especially manifested in white blood-corpuscles, ciliated epithelium, muscle-fibres, nerves, and secreting glands. The agent which thus acts is called a *stimulus*. Such physical stimuli may be mechanical, chemical, thermic, or electrical, and they are regarded as "liberators of energy." As the disturbance of irritable structures by a stimulus is some form of *movement*, either visible or molecular, a stimulus is considered as *added motion*.

Living material is in a continual state of unstable chemical equilibrium, building itself up on the one hand, breaking down on the other, and the term used to express the sum total of these intra-molecular re-arrangements is *metabolism*.

The body is composed of cells. A cell possesses the power of *breathing*, that is, taking in oxygen; of *nutrition*, of building itself up from food materials; of *excretion*, or the getting rid of waste material; but the most obvious characteristic of most cells is their power of *movement*.

The physical energy of these powers of cells can be acted upon by the directed energies of physical agents; and beneficially so when applied in accordance with the physical laws of life. The protoplasm is therefore sensitive or *irritable* to

¹ In physiology the words *irritable* and *excitable* (and their derivatives) refer only to the power of tissue cells to be stirred into activity by an applied stimulus. The common usage of "irritation" in the sense of "annoyance" or "fretfulness," is set aside in physiologic studies. The facts set forth in this section are taken from Howell and Halliburton, 1908 editions of these two authoritative text-books on physiology.

stimuli, and shows its *irritability* by contraction or movement of its mass.

Moderate heat acts as a stimulant. Weak electrical currents stimulate the movement of cells, while during the passage of a strong current the cells assume a spherical form and become motionless. When a gentle current is passed through water in which a number of tadpoles are swimming about they are seen to all fall in line and head in the direction of the current-flow. The relation of cells to various forms of physical and chemical stimuli, especially electricity and light-rays, has been recently very extensively studied. Cells move either from or toward the stimuli, according as they are electro-positive or electro-negative to it.

Cells must eat to live, and we shall see later that electricity can promote their appetite. They are nourished in the following way: When the blood is circulating through the thin-walled smallest blood-vessels certain of its fluid constituents escape by osmosis through the minute orifices which exist for this purpose, otherwise our digested foods could not reach the cells. The fluid part of the blood which thus leaves it to be eaten by the cells is called "lymph." It penetrates to all parts of the cellular elements of tissues and nourishes them. Electricity promotes the osmotic energy of electrolytic fluids such as the blood, by imparting "added motion" to the cells stimulated by it.

A moment's attention to this most remarkable of fluids will reward us. The blood holds in suspension large numbers of solid particles called corpuscles. The normal number of the red (oxygen-carrying) corpuscles is around 5 million to the cubic millimetre of blood, and the white should number ten to twelve thousand. The red pigment of the red cells is hæmoglobin, which contains 0.42 per cent of iron and has the keenest affinity for oxygen. If it loses some of this keenness, or if the number of red cells is greatly reduced, we get "anæmic," which is a state to avoid, being as full of potential disease as was the original box of Pandora. The red cells confine their work strictly to taking on

and giving off fresh cargoes of oxygen as they flow round and round through the lungs. The white cells (leucocytes) have the power of individual movement and can concentrate at a necessary point to repel the invasion of bacterial foes, hence they have been called "the little soldiers of the blood."

During life the blood is in constant movement—*circulating*: leaving the heart by large arteries which divide into diminishing branches and reach their smallest size in thin-walled microscopic capillary hairs of vessels which leak out the lymph nutriment to the tissue-elements and remove from them the waste products of their activity, namely, the ashes left from the combustion of food-fuels burned up in the body in work.

The ashes are carried to the various excretory organs to be eliminated, and the excess of lymph, minus its deposited food materials, is collected again by lymphatic vessels which converge to the main thoracic duct which opens into the large veins near the heart. The lymphatic portion of the blood and the main blood stream returned from the arterial capillaries by the veins, now join in the heart and with fresh cargoes of oxygen and nutriment begin the same wonderful round all over again.

The blood is saline, faintly alkaline, a perfect electrolyte in itself, and is one of the best conductors of electric currents, after metals. By means of rightly directed electricity we can cause it to increase its intake and output of oxygen, accelerate osmosis (a most important factor in nutritional exchanges in all parts of the body), can also increase or decrease the amount and rate of blood-flow through a given part, and in some degree regulate the blood-pressure when it is either abnormally low or high. These responses to electrical stimuli are exceedingly useful, as will be seen later.

We are all interested in keeping well. Nature has many defenses of the body against injury and disease, and some of these increase our medical interest in the *blood*. The acid of the gastric juice is a great protection against harmful

bacteria eaten with food, and the acidity of urine inhibits bacterial activity in that "secretion-excretion," for microbes prefer sugar to vinegar; and the coagulation of blood is a defense against hemorrhage; but far more important and widespread in its effects is the bacteria-killing action of the blood and lymph.

The blood combats bacteria in more than one way—she sticks some kinds together so they can't move, she destroys some by her cell-dissolving "lysins," she neutralizes the toxins of some by anti-toxins of her own; but her supreme method is to *eat them*. When microbes are tasty the white blood-cells, the "leucocytes," will eat them ravenously. This particular kind of destruction of micro-organisms and injurious cells is called "phagocytosis,"¹ and the appetizing constituents of the serum of normal blood which renders bacilli savory to phagocytes—for they must taste to suit or they will be refused—are called "opsonins," from a Greek word meaning "to prepare a feast." The measure of eagerness with which the phagocytes are willing to eat bacteria is called the "opsonic index." To estimate it is a laboratory process.

While even a healthy person has not an unlimited supply of these protective substances in his blood, and can get sick, he is far worse off if the bacteria-killing power of his blood is "run down," for every one knows that he is then liable to "catch anything." Our next chapter will make it plain how electricity can be made to help "run up" the protective power of blood that is "run down," by assisting other remedies and food to do it.

Almost every woman is aware that she has "nerves," and some of the teachings of physiology about them will assist us to understand and relieve a good many "nervous" conditions.

¹ "Phagocytes" are any cells that destroy micro-organisms by the method of enveloping and absorbing them, and are of two varieties; large fixed cells called *macrophages*, and the white blood-corpuscles called *leucocytes*.

The central stations of our two-fold nervous system are the nerve cells in the nerve centres of the brain and spinal cord, and the ganglia of the sympathetics. Our voluntary activities are dominated by the cerebro-spinal centres, and the "sympathetics" preside over the processes of functions which are beyond direct control of our will. When we speak of centres we mean central cells; when we speak of nerves we mean simply the nerve-fibres which are the conducting portion of the nervous system. There are two directions that impulses must be carried—*in* and *out*—hence we have two main sets of nerves. *Afferent* (sensory nerves and nerves of the special senses) conduct impressions from the surface to central cells. The *efferent* nerves (those which conduct impulses from centres to other parts of the body) are classified according to function, as follows:

1. Motor nerves, which supply muscles and muscle-tissue in the walls of arteries and intestines.
2. Accelerator nerves, which control increases in the rate of rhythmical action, an example being the accelerators of the heart.
3. Inhibitory nerves, which influence slowing of the rate of rhythmical action, or its complete arrest. The inhibitory nerves of the heart are a typical example, but many of the involuntary muscles have them also.
4. Secretory nerves, which supply secreting glands, such as the salivary, gastric, and sweat glands. A stimulus to one of these nerves causes secretion in the gland it supplies.
5. Trophic nerves, which preside over the nutrition of the parts they supply.

When a nerve is stimulated the propagation of some change is evident from the resulting effects—movement, secretion, sensation, etc.—but the only alteration in a nerve which can be readily detected as evidence of molecular change is the *electrical* one. All tissues which can be excited to their characteristic action by a stimulus, have internally generated "action-currents" of electricity, those of

nerves, muscles, secreting glands, ciliated epithelium, having been especially studied and demonstrated by Waller and numbers of his followers.

Du Bois Reymond demonstrated that the spinal cord, like the nerves, exhibits an electric current. Gotch and Horsley investigated the currents of the cord very thoroughly. Electro-motive changes also occur during activity in the cortex of the brain. In fact, throughout nature it is almost impossible to have *action* without electricity. Atmospheric electrical discharges occur on an enormous scale, as every one knows, but every one does not remember that even the cleavage of atoms is an action that results in an electrical discharge. Friction produces electrical phenomena, and in every direction we see the processes of nature identified with electrical manifestations.

Waller regards the current of action of any excitable tissue as an index of the magnitude of action, and while we can *see* a muscle contract and witness the results of secretion, yet in a nerve the only available index we can demonstrate is the electrical sign of activity.

Electro-tonic currents must be carefully distinguished from the Normal Current of Action, which is a momentary change rapidly propagated with a nervous impulse. The physiology of the electrical reactions of externally generated currents will not be considered here.

On the question of the character of the *nerve impulse* Howell¹ says: "Of the various suggestions that have been offered the one that is perhaps most worthy of consideration identifies the nerve impulse with the negative electrical charge that is known to pass along the nerve fibre. It is assumed that this moving electrical charge is the nerve impulse."

In speaking of action currents Howell observes: "This phenomenon of a negative electrical condition travelling over the nerve or muscle and giving us an active current

¹ W. H. Howell, Ph.D., M.D., LL.D., Professor of Physiology in the Johns Hopkins University, Baltimore.

when led off through a galvanometer is of the greatest physiological importance, particularly in the study of nerves. It is an invariable sign of the passage of an excitation, or nerve impulse. A nerve cannot enter into activity without showing an electric current, that is, a moving electrical charge."

The actions of tissues may be in response to a *direct* nerve stimulus or to a *reflected* nerve impulse. The latter action is called "reflex." It starts from a stimulus applied to the terminal filaments of sensory nerves on the surface of the body (or a nerve of special sense), travels inward to its central station and there propagates an outward impulse which sets up its action in the tissues that the "outward" connecting nerves supply. Thus deep organs as well as superficial tissues can be influenced by *reflex* action.

The paths of reflected impressions are widespread in the system. Some physiologists attribute almost all actions to reflex stimuli carried inward from our sentinels on the surface, the sensory filaments. But we need not go so far as that. There are plenty of sound arguments against it.

But in medicine the theme of the reflexes is wonderfully fruitful of inspiration to the student of both medicinal and physical therapy. It is a great field for the application of the teachings of physiology. The skin is full of starting points of reflex action and the entire skin is accessible to our reach. Modern scientific hydro-therapy is wholly the utilization of reflexes. Every good treatise on *materia medica* and therapeutics contains a section devoted to treatment by "counter-irritation." Electric currents can be easily dosed and directed in their discharges so as to become the swiftest, best, and most effective of counter-irritant agents in the whole of medicine. And that is only one phase of their comprehensive usefulness. But it is exceedingly important to our patients. And now a word upon a much disputed subject about which every doctor should inform himself:

On Self-Generated Currents of Electricity Within the

Human Organism.—What the average doctor does not know about the more familiar phenomena of electricity makes his mental attitude toward this physical agent very different from that of the scientific physiologist and the highly trained electrical engineer, to both of whom electricity is a practical working partner. Therefore most physicians require some elementary education on this subject and just at this point it is opportune to supply one feature of it.

It seems to be the conclusion of modern physiologists that, "*the basis of a nerve impulse is electrolytic action*"; and another authority, than whom there is none of higher standing among electrical scientists in Europe or America, to-wit; Professor Elihu Thomson, expresses his convictions thus:

"I am quite convinced that ether is the electrical medium, light and radiant heat electrical, and the chemical and mechanical properties of matter in all probability electrical in essence; that matter itself is an electrical phenomenon."

It is scarcely rational for medical men who have never read Maxwell, Kelvin, Thomson, Hertz, Helmholtz, Loeb, and other great authorities to simply oppose their epoch-making contributions with the off-hand remark, "I don't believe it."

The generation of electric currents *outside* of the body began with the celebrated Professor of Physiology at the University of Bologna—by name, Galvani—when he hung the frog's leg between *two dissimilar metals*, a copper hook and a trellis of iron; and when contact was made and broken the fresh muscle contracted.

The next step was the first "battery"—the voltaic *pile* of the celebrated Professor of Physics at the University of Pavia—by name, Volta—when he demonstrated the generation of an electric current by means of his piled up layers of *two different metals* with moisture between them.

From this beginning to the placing of *two different metals*, usually copper or carbon, and lead or zinc, in a jar of fluid electrolyte (now called a chemical cell) was a series of experimental developments. But the basis of electrical action was always *two dissimilar metals* with some solution of acid or salts between them, one of the metals being electro-positive to the other.

Next let us understand what constitutes an electrolyte, and a solution that is an "electrolytic solution"; for the blood is such a solution and all the tissues of the living body are electrolytic in character.

In pure water the molecules with the formula H_2O undergo practically no dissociation into their constituent *ions*.¹ But if a substance like salt is dissolved in the water (and the same is true for most acids, bases, and salts) these substances do undergo dissociation, and the simpler materials into which they are broken up in the water are called *ions*, and they are groups of variously combined "electrons."

Part of these free *ions* carry a charge of positive electricity and the antithetic part of them carry a charge of negative electricity. And when a pair of opposite attractions, such as *two different metals*,² are placed in such an "electrolyte" (electrolytic solution) an immediate migration of the electrolytic ions ensues.

The positively charged ions move in procession toward the negative attraction, and the negatively charged ions move in a like procession toward the positive attraction; for it is the law in physics that "like electricities repel" and

¹ As the word *ion* is so much used in electrical writings the reader should be as familiar with it as with the word atom. Ion means *going*. As the electrified molecules or molecules of electricity in an electrolyte are the "going" current the Greek word *ion* has been applied to them. So we have positive and negative ions as the migrating carriers of an electric current through every substance or fluid which is of the nature of an electrolyte, this word distinguishing the character of electrolytic conduction from conduction by metals.

² In a chemical cell the electro-positive metal element undergoes electrolysis (decomposition).

“opposite electricities attract.” And the moving streams of electrically charged ions are the two poles of an electric current. We have only to lead it out of the jar by conducting wires and through any desired circuit to obtain the use of the generated electricity.

How do the *ions* get their charges of electricity? *They take it with them as the energy liberated by the dissociation of their parent molecules.*

Physiology states that the elements found in the body are carbon, nitrogen, hydrogen, sulphur, phosphorus, fluorine, chlorine, iodine, silicon, sodium, potassium, calcium, magnesium, lithium, iron, manganese, copper and lead. From this supply Nature has ample choice from which to equip her infinitely miniature “chemical cells.” A battery cell the size of a thimble can generate enough current to cable an impulse across the Atlantic and Nature does not require a horse-power dynamo for the processes of her metabolism. Myriads of her nerve fibres are too small to be seen with the most powerful microscope.

It is therefore no longer difficult to comprehend the sources of internal self-generated, or self-liberated, electric currents of small magnitude to act as stimuli for the protoplasm and as conductors of impulses from nerve centres to all parts of the body.

It would be harder still to assume that Nature forgot her laws and suspended within the body her actions out of it. Out of the body it is impossible to juxtapose certain elementary conditions without establishing electrical action—actions going on everywhere in the universe, from the cleavage of atoms to the hulls of iron ships in salt water; from the stresses in ether to electrolysis in pipes in the ground; and in thousands of combinations of salts, metals, and moisture, the world over.

Physiology has long stated that the human body is a great “electrolyte” (which means, “any substance decomposable by electricity”) and from this knowledge to its logical sequence that having the requisite conditions for

the liberation and action of electric currents we therefore have the natural result, must be the unavoidable conclusion of science.

There is no doubt that Nature has the currents for use in the living body. The question is, "What does she do with them?"

In his book on the "Dynamics of Living Matter" Jacques Loeb, Professor of Physiology in the University of California, remarks on electrical phenomena in living organisms:

"It is hardly possible that differences in electrical potential can arise in any other way in the tissues than by a separation of the positive and negative ions of the electrolytes dissolved in the tissues. As the difference in the rate of diffusion for different *ions* always exists, especially when acids or alkalies are formed, and as a difference of the permeability of the protoplasm for oppositely charged *ions* may also easily exist or arise, it is not difficult to understand that *so many life phenomena are accompanied by electrical changes and currents*, as when light falls on the retina or when glands secrete, or muscles contract.

"This lends perhaps support to the idea expressed by Hermann that the current of action is the cause, or means, of the propagation of nerve impulse. Bernstein has found that this negative wave is propagated with the same velocity as the nerve impulse, so that there exists a possibility that this difference of electric potential which originates upon stimulation is the cause, or the means, of propagation for the nerve impulse.

"Waller has been able to determine the beginning and the cessation of life in eggs and seeds by galvanometric tests and these facts furnish a further indication that *all life phenomena are accompanied by electrical phenomena*. We shall see later that salts play a great rôle in life phenomena and it is obvious that if changes in the nature and number of ions in a solution accompany life phenomena, electrical phenomena must also be a *necessary consequence*."

Medical skepticism and prejudice against electricity can mostly be resolved down to a case of "I didn't know" on

the part of the non-posted majority. Admiration for this very exquisite ally of medicine increases with one's knowledge about it, and the authoritative facts of these chapters cannot fail to impress even the most uninformed with the magnitude and dignity of this physiologic agent.

CHAPTER III

LIFE PHENOMENA AND ELECTRICITY (Continued)

Nature's Processes from Muscles to the Alimentary Canal. Fatigue and How to Get Rid of It. The Circulatory System: Its Vasomotors and Functions. Osmosis and Metabolism. The Respiratory System and Its Mechanism. Nature's Electrical Stimuli. The Pancreas. A Universal Physiological Truth.

FROM nerves to *muscles* is a natural step. Muscle, the flesh of the body, makes up 42 per cent of our weight. Its great physiological function is *contraction*, with the disuse of which *all other functions stop*. With the normal exercise of muscle-function *all functions flourish* and strength grows.

Muscle undergoes many changes when it contracts. The chemical changes are more energetic than at rest and more heat is produced and its temperature rises. It also undergoes a change in its normal electrical condition. It first becomes more electro-positive and then falls back to electro-negative, and in a succession of contractions (in all our work and movements) this electrical activity is going on in the muscles all the time. Hermann, in particular, has demonstrated and explained the action-currents of muscle tissue.

In the living animal muscles are always in a state of "tonus," *ready* to contract when called on without losing time or energy in taking up slack. This important *tonus* is under the control of the nervous system, and it can be "toned up" (when weakened) by an electric current externally reinforcing its own. We may demonstrate the immediate action of this by having a patient hold out his arm with a weight in hand until it is ready to drop. With the added tonus of an electric current he can continue to hold it out much longer without fatigue. In the treatment of debility no other means of energising muscles and nerves, and

thereby *invigorating all other functions*, can be compared with electricity.

It is not only the chief muscle-contractor of the physical agents, enabling the physician to exercise passive muscles to any extent and degree desired, but it does this service with the body at rest, without taxing the heart, without requiring motor-impulses of the brain centers, and without afterwards reacting on them with the toxic products of fatigue.

The chemical changes in a contracting muscle consist in an increased consumption of oxygen, and an increased production of heat by oxidation, together with an increased output of waste materials. By electrical exercise of muscles we favorably affect the activity and amount of these chemical changes. The extraordinary physiologic beauties of the skilled exercise of muscles by this tonic stimulus and promoter of all functions, remain for the most part to the medical profession and the public, as the Garden of the Hesperides to a host of blind men. Yet in health or disease we may benefit by it.

A characteristic of "smooth" muscles (those of the intestinal tract) is "peristalsis," or worm-like contraction instead of the familiar action of the "striped" muscles. If any point of the small intestine is stimulated, a ring-like constriction appears as the result. After lasting some time at the original spot the contraction slowly passes along the tube at the rate of 20 to 30 millimetres per second. This advancing peristaltic wave normally takes place only in a downward direction and so serves to drive on the contents of the intestine. It can be stimulated in various ways by electrical energies. Smooth muscles do not tetanize under faradic currents.

To every person who has ever been "tired" the subject of *fatigue*, or the way to get rid of it, possesses intrinsic interest. We are apt to say that our muscles or our nerves are tired, but that is not so, as we shall now see.

The sense of fatigue in a muscle as the result of prolonged work is due to the combustion (burning up) of the

substances available for the supply of energy in the muscle—but more acutely due in particular to the accumulation of waste products of contractions, which collect faster than they are carried out of the tissues.

By the method of “graphic tracings” the “curve” of a normal muscle is ascertained. Then it is studied under continued contractions. Fatigue gradually reduces the curve, prolongs the latent period of relaxation, and, if carried to the end, makes further efforts at contraction impossible. If the arm muscles have been thus taxed the arm drops as if paralysed and can no more be forced to further work in chronic fatigue than we can push on a string. This is the heart-breaking and wage-destroying condition that overtakes the telegraph operator when he has “writers’ cramp.” There are fifty thousand cases of it in this country.

The question of absorbing interest is, *where is the seat of fatigue?* The present writer puzzled over this question for many years, during which he personally treated more victims of writers’ cramp than perhaps any other physician in this country. Is the fatigue in the nerve, the muscle, or the end-plates? ¹

By tests and processes of exclusion physiologists have determined (and our own practical experience confirms them) that:

1. The *muscle* itself is not to any great extent the seat of exhaustion.

2. The seat of exhaustion is not in the *nerves*.

This cuts out two of the three local possibilities and there is only one left, therefore:

3. The localized seat of fatigue is in the nerve end-plates—but,

4. The fatigue toxins (the products of muscle metabolism during work) *still more speedily jade the nerve cen-*

¹ The *end-plate* is the flattened terminal disc-like expansion with which all motor nerves end in the tissue of the muscle fibres they supply. The motor impulses sent to each fibre reach the end-plate and the contraction starts from that point.

tres and diminish their power to send out impulses. The central cells are far more sensitive to the toxins than are the working ends of the nerve-fibres, and hence they are first to express fatigue.

It is Nature's way of protecting us from over-doing. The chief waste products of muscle work are carbonic acid and sarco-lactic acid. Carbonic acid will stupefy any tissues that breathe an excess of it. Carbonic acid poisoning is asphyxia, and persons overcome by gas suffocate. It is a matter of common experience that one's mental state influences markedly the onset of fatigue and the amount of muscular work one can do.

What we call fatigue of our muscles is in reality an expression of too much carbon dioxide or carbonic acid in the motor centers, making the cells dull with the heavy drowsiness of a narcotic. The remedy is to drive out the toxins and refresh the cells with oxygen, and fortunately we can make electricity do this, and do it easily and quickly.

The reason why the seat of "fatigue" is not in the muscle-fibres is because they have great powers of endurance, are very resistant to toxins, do not contain any of the by-products of their own metabolism, and are willing and able to work long after their owner is able to drive them by his own motor power. Again, the agent that demonstrates this to physiologists is electricity.

The reason why the seat of fatigue is not in the nerves is still better. It is practically *impossible to fatigue nerves*. Waller, the great investigator of the nervous system, showed that nerves are not *fatiguable*, not because no metabolic changes occur in transmitting impulses, but because the change is so slight and the possibilities of repair so great—the re-supply of energy so inexhaustible—that fatigue in the ordinary sense of the word cannot be demonstrated in nerves. It is demonstrable only in the nerve cells of nerve centres. One of the greatest physiologists remarks: "When one considers how many of the nerves are in constant action

throughout life we should hardly expect nerves to be peculiarly susceptible to real fatigue." This should be comforting to the thousands of people who have been told that they were suffering from "nervous prostration." It is something else.

The *Circulatory* system and its nervous mechanism comes next in order in our study of nature's methods. The great function of the blood is to convey nutriment to all the parts and remove from those parts the waste products of their activity. It is kept going at many different rates of speed by the pushing force of the heart-pressure at each powerful contraction of the heart muscle at the start; is helped to keep "flowing" by the elastic recoil of arterial walls and the pressures of contracting and relaxing muscles in its course; and is pulled forward to some extent at the slower finish by the suction-force of the emptying lungs. As its share in the process it is estimated that the work of the heart as nature's force-pump per day is equal to the work done by a vigorous laborer working hard for two hours.

The nerves which control the movements of the heart are branches from the pneumogastrics and sympathetics—inhibitory, accelerator, augmentor, and depressor. Slowing or arrest of the beats of the heart results from stimulation of one or both pneumogastric nerves. Stimulation of the sympathetic nerves accelerates the heart beats and augments their force. These are important points to remember in electrical treatment.

The normal balance of rate and force of cardiac contractions is maintained by the cardiac centres in the medulla, which are always in action, and which are the seat of the heart reflexes. The restraining influence of the centre of reflex inhibition in the medulla may be greatly increased by stimulation of many sensory (surface) nerves, particularly those from the nasal mucous membrane, the larynx, and the lungs. A blow on the abdomen causes inhibition of the heart and faintness; a blow on the larynx, even a moderate one, may kill.

Tobacco smoke in some people may affect the terminations of the nerves in the lungs or larynx and thus induce inhibition of the heart. This explains why it is impossible for some people (especially those with irregular hearts) to breathe without distress in a room with smokers. It is not a whim; it is the compulsion of nature. Emotional effects on the heart are another phase of reflex action.

The electrical, thermal, and chemical changes in the heart muscle during action are similar to those in the voluntary muscles of the body. The most potent artificial stimulus that can be applied to the nerve to induce inhibition or influence the heart is a rapidly interrupted induction current of electricity. And it should not be forgotten that through every stage of circulation electrical stimuli can be directed to act on its fluids and vessels, and on all the functional exchanges which take place via the medium of its constituents.

In medicine we have much to do with what are called "vaso-motor" disturbances. Let us now look up the cause of them, as they are identified with the circulation. Moreover, they are very common and should be understood.

Vaso-motor (vessel-motor) nerves are those which preside over the movements of blood vessels. Some *constrict* and some *dilate* the vessels and by their opposing forces maintain a proper equilibrium in health. A little too much constriction or a little too much dilatation, and we have a "vaso-motor disturbance." The consequences of it depend on cognate things.

The main vasomotor centre is in the brain. The spinal cord has subsidiary centres. And these centres, together with the two sets of nerves, constitute our "vasomotor system."

The great specific function of this system is to regulate the amount of blood furnished to the capillaries of any organ at any time, and adapt it to the needs of the organ according to its activity or the opposite. For instance, during digestion the stomach requires an increased amount of blood as mate-

rial from which to secrete the gastric juice. Pale with little circulation in its walls prior to the intaking of food, at meal time its walls redden and grow rich in warmth and energy as the vasomotors pour through its vessels *fourteen* times the amount of the previous blood supply. But blood cannot be in two places at once and we have a correspondingly less amount in other areas, such as the skin. This accounts for the chilliness often felt after a meal, and also explains why work should not be begun immediately after hearty eating.

The constriction of the vessels of the skin in cold weather to retain the body heat, and their dilatation in hot weather to promote perspiration and escape of excess heat, is another example of vasomotor regulation of supply to our needs.

The vasomotor centre can be directly excited by induction currents. It can also be excited reflexly by electrical stimulation of its afferent sensory nerves. Almost all the sensory nerves contain vasomotor fibres and hence the whole extent of vasomotor influence (which is co-extensive with our arterial and capillary vessels) is subject to electrical stimuli. Halliburton says: "It is almost impossible to overestimate the importance of the study of vasomotor phenomena as a means of explaining certain pathological conditions. Inflammation is a case in point."

Along with this we must also remember that the vasomotor centre is disturbed by the irritant action of poisons in blood which circulates through it, and by venous blood; and this explains the high arterial pressure in certain diseases. Also the hot head and cold hands and feet of other conditions. When the cause is functional and temporary an electric stimulus can be made to restore the equilibrium quicker than a cook could make a cup of tea. We have done it many times.

Furthermore, if the tone of the skeletal and vascular muscles be suddenly inhibited by fear, or impaired by "shock," the blood will drop by gravity-weight into the dilated ves-

sels of the most dependent parts of the body. The natural remedy, when it can be used, is an electric current to the spinal centres and to the muscles. We have seen it act with greater swiftness than any other remedy.

Now let us go back again to the blood as a means of nourishment. The *osmotic* phenomena of the fluids of the body are of exceeding interest, especially as an example of electrical influence on the processes of human life. Recent investigations of eminent physical chemists have given new conceptions to the physiologist. So says a chief authority.

We are, fortunately it seems when we study osmosis, largely made of water. Water constitutes 90 per cent of blood plasma and 75 per cent of our muscles. The molecules of water are in constant movement. When acids, bases, and salts, are dissolved in the blood they undergo dissociation, and the simpler materials into which they are broken up are called *ions*, and are groups of the elementary electrons. Certain of them become charged with positive electricity and others assume a charge of negative electricity.

Substances which exhibit this power of dissociation are "electrolytes," and the liquids of the body therefore contain electrolytes in solution. This makes them good conductors of electric currents—self-generated in the organism or externally applied by physicians. When an external electric current, as a small galvanic current, is led into such a solution it is conducted through it by the movements of these ions. The electro-positive ions move toward the negative pole and the electro-negative ions move toward the positive pole.

At this point our medical interest in osmosis begins touch with practice. Osmosis is defined as the passage of a fluid through a membrane, but literally, in the case of the blood, it is the in-and-out filtration and interchange of selective materials in the blood through spaces ("os" means mouth, and "mosis" refers to movement) in the exquisitely delicate walls of the finest vessels.

Osmotic pressure is greater the greater the number of

ions in the solution. Osmosis works two ways—*exosmosis* (out) and *endosmosis* (in). The last function of digestion is an exosmose of the prepared nutriment from *within* the distributing lymph walls *outward* to the tissues ready to “absorb” their food. Their first step in the excretion of waste products from out of the tissues is their endosmose *into* the same lymph vessels, mingling with the fluid and again doing the reverse in the different excretory organs through which the blood flows. Electricity can be made to influence and *increase* the *energy, activity, and completeness* of this essential process.

We now come to the great function of *Respiration*, of which a philosopher has said: “You live as long as you breathe.”

In the central nervous system there is a small district called the respiratory centre which gives out impulses that travel down the cord to the spinal centres that innervate the *muscles of respiration*. For breathing is a muscular process and our lungs are enabled to breathe only by the muscular work of their environment.

The importance of this physiological fact in this study of nature's methods arises from the readiness with which we can make electric currents stimulate, energize, and strengthen the contractions of every muscle concerned in the respiratory mechanism.

The respiratory centre also receives various afferent nerve fibres which exert reflex influences. In the vagus nerve are two sets of nerve fibres, one of which increases the activity of *inspiration* and the other of *expiration*. The vagus can be readily stimulated by an electric current and the function of respiration energized. It is one of the simplest things to do.

We can therefore direct electricity so as to make it functionate the respiratory muscles, re-establish their energy in debilitated states, enhance a diminished breathing capacity to as near normal as the essential damage (if any) to the air cells will permit, and (when there is no organic damage)

completely and rapidly restore the whole mechanism—chest and lungs—to a sound state.

Examples of this action may be witnessed in the treatment of all stages of ordinary bronchitis, in the swift restoration of the organs after pneumonia, and is also demonstrated with great beauty in the treatment of incipient tuberculosis. In any case of tuberculosis not too far on the way to the third stage, we may at least offer the help that a fresh horse gives a tired team up a hill, and this uplift alone is often the support and comfort of a few more years of life. In grave though incurable disease the help of electricity is never to be despised. In purely functional inhibitions of part of the respiratory capacity we have over and over again in scores of cases made it release the *centre* from its incubus and restore full breathing power, almost as the crack of a whip makes a small boy let go a hitch on the back of a wagon.

There is a very close inter-dependence between Circulation and Respiration. Arterial pressure rises with inspiration and falls with expiration, and the heart beats more rapidly during the rise than during the fall.

The intake of oxygen is the commencement, and the output of carbonic acid is the end, of the series of changes known as "respiration." Pulmonary respiration is but the means and *tissue* respiration is the end of the process. "Tissue-respiration" is the actual combustion that takes place all over the body. The oxygen taken into the blood from the air cells of the lungs, is held there in loose combination as oxyhæmoglobin. Moderate exercise increases the intake and absorption of oxygen and causes an increase of from thirty to forty per cent in the amount of carbonic acid excreted. With excessive work the increase is still greater.

And now comes the inspiring dictum of physiology: "*The proneness to pathological change as well as the vascularity of the tissues of the body is connected with the degree of metabolism of the tissue.*"

That striking and reassuring truth is the handwriting on the wall, pointing out to us the path of nature and bidding us follow where she leads. The influences for good that electric currents can be made to exert on the extent and degree of metabolism will be partly shown in our succeeding chapter on the medical actions of high frequency discharges; but no novice, no mere reader of things that are done by electricity, no physician without the enlightenment of experience, can more than faintly appreciate the good he can do his patients by nature's guidance and electrical stimuli.

It has been truly said that the *stomach* is the house we live in and we shall now consider the functions of the *Alimentary Canal* and the hints of the physiologist to the physician.

Opening into the canal, which comprises the mouth, œsophagus, stomach, and small and large intestine, are numerous glands that pour their secretions into it. These juices supplement each other and in a series of orderly steps bring about the digestion of the variously constituted foods as they pass slowly along the muscular tube.

Thus, the acid *gastric juice* reaches the small intestine and there stimulates the production of *secretin*; the secretin is taken by the blood stream to the pancreas where it excites a flow of *pancreatic juice*; this arrives at the duodenum ready to act on starchy substances and fats; the *bile* aids the liberation of fatty acid which in its turn forms more secretin and hence more pancreatic juice; *succus entericus* then comes in to supply the *ferment* that sets free the *trypsin*, and this, with the aid of *erepsin*, effectively carries out digestive proteolysis.

The nerve supplies of the alimentary canal are mainly derived from the pneumogastric and the sympathetic, with various plexuses here and there, and the great solar plexus (the abdominal brain) on the dorsal aspect of the stomach. The solar plexus is a great network of sympathetic nerves and ganglia formed by the splanchnic nerves and the right

pneumogastric, and giving off branches to all the abdominal viscera. It fully deserves its reputation.

The normal movements of the stomach during gastric digestion are in part controlled by the plexuses of nerves and ganglia contained in its walls, and in part by branches of the vagi and splanchnics through the solar plexus. Stimulation of the vagi which contain the *accelerator* nerves of the stomach produces peristaltic movement. The *inhibitory* nerves are the sympathetic fibres and when they are stimulated the movement of the stomach stops.

The normal stimulus to secretion and muscular movements (work) in each part of the alimentary canal in turn, is the presence of food for it to work on. Few or no movements occur when the viscera are empty.

Electric currents can be made, as we have seen elsewhere, to stimulate the functions and secretions of the cells of glands, the impulses of nerves, and the contraction and movements of muscle fibres. *The physical conditions affecting digestion and under which nature carries it on can therefore be influenced by electricity.*

Stimulation of the *chorda tympani* produces an abundant secretion of saliva. The famous *chorda tympani* is the great nerve of taste, secretion, vaso-dilation and sensation which supplies the tympanum of the ear, and the submaxillary gland, inferior lingualis and tongue. When we excite it with an electric stimulus both patient and physician can speedily note the increase in saliva. The results occur where we can see them. Similar results follow electrical stimulation of *all* secretory glands, in proportion to their normal activity and the directness of the stimulus, and some can only be reached through reflexes.

But while electricity is so commonly called a "stimulus" it is also a "regulator" of function, or can be made so by right direction of its stimulus in the proper nerve channels. In one of our former books we reported at length a case of excessive and constant salivary secretion from the irritation of a cancer of the tongue. A profuse watery discharge of

this kind is called a "paralytic" secretion, for nature loses control of inhibition and the power to check the outpouring is paralysed. This man would soak in succession ten large absorbent pads placed on his pillow at night to catch his dribbling. Under an electrical stimulus both secretory and inhibitory control gradually gained energy, the serous discharge became more mucous, quantity diminished daily, and after three weeks' daily (or nearly daily) treatment this particular function became practically normal and remained so for a long time. Such practical observations as these are convincing.

Mechanical excitation of the stomach produces no secretion of gastric juice but electrical stimulation of the vagus nerve usually results in an abundant secretion of the gastric juices.

That we can make electricity tone up a slackened function of the pancreas we may find indirect evidence in our results in certain cases of diabetes as well as in other ways.

The great little giant, the pancreatic gland, lying between the spleen and the duodenum, is the source of trypsin, amylpsin, steapsin, a milk-curdling ferment, alkalines, and other complex additions to the digestive juices that pour into the highway of the food. It helps digest fats, sugars, and starches, and removal of the pancreas in animals, and disease of the gland in man, not only involves a loss of part or all of its digestive secretion but also creates a form of diabetes. Speaking of this the physiologist observes:

"The pancreas must have functions relating to the general metabolic phenomena of the body which are disturbed by disease of the gland. And this is an illustration of a universal physiological truth—viz., that each part of the body does not merely do its own special work but is concerned in the great cycle of changes which are called general metabolism. Interference with an organ not only upsets its specific function but causes disturbance of the body generally."

In a large number of early cases of diabetes we are able to make electricity improve the activity of metabolism, or so influence its equilibrium that the sugar is burnt up instead of being lost in the urine. In cases dependent to some extent on deficient pancreatic juice our results may be due in part to restoring the secretory functions of the gland. As many physicians report relief of diabetes by electrical stimuli to the metabolism we are obliged to concede its influence.

The liver properly comes next, but in passing from the left to the right side of the body it will take but a moment to speak of the *spleen*. This blood-forming organ exerts profound influence upon metabolism but no amount of research has yet induced it to disclose all its methods and functions. A good deal is known but the details are obscure. What we wish to say now is this:

“By stimulating the spleen to contract in a case of splenic leucocythæmia by means of the electric current applied over the spleen through the skin, the number of leucocytes in the blood is almost immediately increased.”

This is not the “fanciful claim of an advertising quack” but the statement of a standard text-book on physiology, published in 1908.

CHAPTER IV

LIFE PHENOMENA AND ELECTRICITY (Concluded)

The Liver; Its Functions and Influence. Diet and Metabolism. The Urinary Apparatus. Urea and Uric Acid. Trophic Nerves; Their Control of Nutritive Processes. The Spinal Cord and Its Relation to Electrical Stimuli. The Skin and its Functions. The Importance of Capillary Circulation. How Electricity Reinforces Nature.

THE *Liver* now engages our attention—the largest gland and the most pesky organ in the body.

Home of the hypo's and of headache; hive of blue-devils and source of suicide; target of pills; victim of abuse or neglect; millstone to the mind; the fount of depression; the womb of worry; the mother of gloom; the great reservoir of uric acid; the seat of biliousness and cause of cold feet; heart of foreboded ills and solar-plexus panic—a good liver is a man's best friend, a bad one is often his worst enemy.

No man with a torpid liver should ever make important judgments until he gets it clear.

The liver has five fissures, five lobes, five ligaments, and five sets of vessels besides its ducts and gall-bladder, and weighs from three to four pounds unless enlarged. *The whole blood of the body passes through the liver about once a minute.*

Every one knows that the liver is the fountain of bile but it is equally important to remember that this great complex and vascular viscus is a busy gland, having to attend to many functions which are required by general metabolism and good health. These varied functions are as follows:

The liver is nature's great factory for the formation of urea. In the liver cells its precursors of protein metabolism

that accumulate in the alimentary canal are collected and made over into the completed form of urea for physiologic excretion by the kidneys.

The liver has brought to it much of the uric acid formed in the tissues and is a storage and conversion depot for the destruction or change into urea of part of it. Besides its relation to these two excretions of the urine the liver also assists the kidneys by taking over some of their excretory work when acute illness overwhelms them and temporarily clogs their powers.

The liver is one of the blood-forming organs (as is also the spleen) and aids in the retirement of worn out blood-corpuscles and the evolution of new ones.

The liver forms the pigment "bilirubin," an iron-free derivative of hæmoglobin, supposed to be collected and stored in the liver cells for future use in the manufacture of new hæmoglobin, in which the liver assists.

The liver cells collect and excrete via the intestinal tract the end-products cholesterin and lecithin, the first of which Flint regards as the waste product of the functional activity of nerve tissue.

The liver cells secrete the special *diastase* which digests animal starch—turns it (the glycogen) into sugar so that it can be burnt up in the tissues and its energy liberated for heat and work.

This great "glycogenic function" of the liver consists in collecting the maltose (the partially digested sugars and starches of our food) brought to it by the portal vein, storing it in the hepatic cells and then converting it into sugar by the agency of its ferment (liver diastase) which the liver secretes for this purpose; the sugar being, as fast as needed, carried away in the blood of the hepatic veins to undergo combustion in the tissues, mainly to produce heat or its equivalent in work. When the sugar-forming or sugar-burning process is unbalanced we have "glycosuria," and of this we shall speak again in a moment.

The liver cells secrete and furnish to bile the important

laxative cholagogue and digestive salts, sodium taurocholate and sodium glycocholate, which actively reinforce the pancreatic secretion and are of great consequence to intestinal digestion.

Lastly, this hard-working organ produces about a pint of bile a day.

In addition to the foregoing duties of the liver for the public benefit of the individual it must also eat, rest, and repair its own cells and negotiate the conduct of its own personal metabolism.

Bile is the compound biliary fluid being constantly secreted in the liver cells and stored in the gall-bladder between meals to be poured into the alimentary canal as needed during digestion. The duties of bile are numerous. It mingles with the mass of dissolved and liquefied food as it passes from the stomach, creates viscosity in this "chyme" and promotes its absorption in the intestines.

The alkalinity of the bile aids the pancreatic juice to neutralize the acidity of the chyme previously resulting from the acid gastric juice. Although bile is not antiseptic it yet lends great aid in diminishing putrescence and preventing foul odors in the fæces. It is a solvent of fats and fatty acids and assists in the digestive absorption of fats in foods. This is one of its most important digestive functions.

The nerve supply of the liver cells reaches the liver from the vagus, and after section of this nerve sugar disappears from the blood and glycogen disappears from the liver and tissues generally.

The vessels of the liver are supplied by the vasomotors. All the functions of the liver are influenced by stimulation of its nerve supply.

Stimulation of the spinal cord or splanchnic nerve diminishes the secretion or flow of bile. Inhibition of the splanchnic may cause an increased secretion or flow. These actions are explained by the influence of these nerves (the vasomotors) on the blood-flow through the liver. The secretion

increases when the blood-flow is increased and diminishes when it is lessened. The metabolic processes which produce bile are going on all the time but they are more active during an increase of blood-supply for them to extract their materials from.

Almost no laxative or cathartic drug agencies increase the actual amount of bile secreted. They only cause it to be emptied out.

By exerting influence on the vasomotors an electric stimulus can be made to promote the secretion of the liver cells when circulatory torpor handicaps their work. By instituting more favorable conditions we increase the amount of bile the cells can make in the given time.

As all cells in the body respond to electrical stimuli the influence upon the vasomotor nerves and the blood supply is reciprocal with that exerted upon the liver cells, the result being expressed in better functionation all round. The reflex stimulation of the liver cells and vessels by an electric current of high potential may be illustrated by two very common examples in the experience of the author.

In a case of habitual constipation in a sedentary worker a counter-irritant and muscle-contracting application over the region of the gall-bladder and liver and epigastrium had a cholagogue laxative effect within ten minutes. In the second case, a male, aged 30, was treated in a similar manner. After a few treatments he reported that he was having mercurial action on his salivary glands and enquired as to the cause. It transpired that six years previously he had specific treatment but had taken no mercury since. The electrical stimulus to the liver cells had set free their locked up residue and systemic action resulted. After this elimination he felt marked improvement.

Before leaving the liver and its great functions we will add a word about diabetes to complete the subject which we mentioned in connection with the pancreas. While glycosuria (presence of sugar in the urine) may be due to

other disorders of metabolism (mainly temporary) the usual condition in diabetes mellitus in man is the inability of the organism to utilize—burn up—the sugar in the proper way, in the due course of metabolism. Part of this inability may be defective functionation of the pancreas, or excessive function of the liver, or inhibited oxidation in the tissues, but that it is a metabolic fault of some kind is the agreement of current medical opinion. Therefore the effort of treatment should be directed to restore the functional equilibrium of metabolism.

The attempt to “beat the devil around the stump” and prevent loss of sugar by the device of not eating any does not appeal to reason, for sugar and salt are imperatively demanded by animal tissues. Muscle substance even in carnivorous animals in the wild state, as the lion, looks to some sugar for its concentrated high-power food-energy. If it is possible to restore the sugar-burning function of the organism our main means of doing so is to be found in the application of electrical stimuli to the processes of metabolism. Many cases have been successfully treated, and all cases should be offered the benefits of early and adequate electro-therapy.

But metabolism is kept going by what we eat, hence *diet* assumes a rising importance in the dealings of medicine with disease. Foods are classified in two grand divisions: *flesh-forming* and *heat-forming*. Proteins, carbohydrates, and fats.

The nutritive value of a diet depends chiefly on the amount of carbon and nitrogen it contains for oxygen to act on—oxidize. A man doing moderate work and eating a usual diet will daily eliminate, and mainly via the lungs, 250 to 280 grammes of carbon. He will at the same time eliminate (as urea in the urine) 15 to 18 grammes of nitrogen. These substances result from the conversion of food-fuels and body-tissues into the forms of energy—motion, heat, etc.,—that do our work. Thus, working strength is closely wrapped up in the activity of metabolism. We

never get far away from *metabolism*. In health or sickness it is the *alpha* and *omega* of us all.

The great influence which electric currents can be made to exercise in promoting the activity and completeness of metabolism is never to be forgotten. As is his *metabolism*, so is the *man*.

In acute illnesses the medical regulation of temporary diet means much, but in the long course of chronic diseases few people gain permanent advantage by dietetic advice. The deprivations so often maintained for long periods unbalance nutrition; and a one-sided starvation is ultimately as bad as a disease and is never scientific treatment. Far better tone up the cells, nerves and functions, and increase their power of metabolic exchange—enable them to liberate the energies of a wholesome and sensible diet—rather than to rob the tissues of necessary support because in the given state of metabolism the unaided powers of nature fall short. The whole study of the effects of electrical stimuli on cells, nerves, blood, circulation, glands, and functions, points us to this moral.

But what and how much should a well man eat? Some hold that we eat too much. Chittenden tried to prove this by classical experiments on himself, his colleagues, his students, and on soldiers and athletes. He reduced their protein to half or less. No one "starved." Health remained "perfect," or "improved." Mental keenness was undiminished and muscular force increased. His experiments lasted for months—and then most of his diet-squad *went back to their old rations*.

Then Chittenden announced his great economic theory. It looked sound, but is it? Can the experiments of a few months upset the *law of the conservation of energy*? and can we be made to believe that nature's law does not apply to the chemical changes in a living animal—man? The advocates of this fad cite a large amount of work done on deficient food without loss of weight, forgetting that fat may be replaced by water, the retention of which in the

.

tissues is a marked characteristic of the carbohydrates which such people eat. *Deficient diet tells in time.*

Chittenden's own figures show that there was in some cases a distinct impairment of absorptive power. Moreover, the poor around us have had to subsist on a Chittenden diet for years instead of merely for months, and their condition does not incline us to follow their example. The underfed are universally preferred soil for disease. What can be expected of *opsonins* which are underfed themselves? The statistics of tuberculosis partly show.

In India the vegetarian and ascetic natives succumb far more readily than the heartier and meat-eating English among them. If we regularly reduced our limit to the Chittenden level we might soon skate on thin ice, and any unusual strain, deprivation, acute illness, or exposure to microbes, would find us without reserve nutrient energy and we would suffer severely in consequence.

But still the question arises, "Why eat what the body casts out in a few hours, and therefore an evident excess?" The answer is manifold. Nature does not work in *minimums*, and the least is not the *best*. Reserve energy, stamina to enable the bodily-tissues to resist bacterial enemies, endurance and working strength, high mental powers, progressive development of the race, are not permanently provided by the unbalanced diet, or by the insufficient diet, or by any diet when metabolic exchanges are impaired.

Inside our bodies proteins are the most readily burnt of any food materials, and have a specific value in stimulating metabolism and leading to an increased oxidation and warmth. Some of Chittenden's subjects on reduced proteins suffered intensely from cold in winter. For among the most important results of the chemical processes called metabolism is the production of *heat* to maintain our necessary normal temperature of blood and body.

The whole logic of the "rest-cure" and of the routine treatment of tuberculosis is against the "minimum diet" theory. The overfed can find profit in it temporarily, but as

a working plan for the rest of us the theory is fallacious. Reasonable discretion in eating, with a reserve of tissue-resistance and a high index of opsonins in the blood, is safer than to follow in the footsteps of food-faddists.

And although it appears true that most of the cruder products of food seem to be cast out of the system so abruptly that the wise may ask why they were taken in, yet there are some elements in all which are especially precious for tissue reconstruction and *it is for these* that nature puts up with the excess of waste. The large size and normal activity of the liver seem to be for the express purpose of dealing with the coarser waste rapidly—and it is this coarse stuff mainly that keeps the bowels open. Concentrated diet means costive bowels. Therefore, the vote of nature is against Chittenden.

The *Urinary Apparatus* has received more attention from the physiologist than from therapeutics, for medicinal therapy is limited in this field; but urinalysis in aid of diagnosis has grown to be one of the great resources of the profession. With the laity “kidney trouble” is a favorite term.

The kidneys are situated deeply in the lumbar region of the abdomen, and by their complex excretory and selective filtering mechanism they separate from the blood that circulates through them the waste products that compose what we call *urine*.

The nerve supply is derived from the renal plexus of each side. The nerve fibres come from the lower dorsal spine and are vasomotor *constrictors* and *dilators* in function. Therefore an electrical stimulus can be made to exert an influence of great importance on the kidneys by exciting its reflexes. This action is of the highest medical value and compels our attention.

The kidneys have no true secretory nerves for their work is *elimination*. Some drug diuretics act locally on the kidney, and others act on the general blood pressure. At times drug diuretics impose a serious strain on the renal epithelium, but electrical stimuli impose no strain whatever upon

any organ to which they are rightly applied, for their influence is physiological. We shall see the usefulness of this remedy when we consider Bright's disease in our therapeutic section of this book.

The Dr. Jekyll and Mr. Hyde of the urinary excretion are *urea* and *uric acid*. Neither are made in the kidneys but the kidneys get them out of the body; or if they fail, convulsions result, coma and death following. This fact lends intrinsic interest to urination.

Normally, on a hearty mixed diet, the liver manufactures and the kidneys excrete, about 500 grains of urea per day. It is the chief nitrogenous constituent of the urine and is the final product of completed protein decomposition—the destructive side of the metabolism of nitrogenous materials in diet and the tissues. When we create the normal quantity of urea and eliminate it this part of our nutrition reaches perfection.

Uric acid is the plague of sedentary people and hearty eaters. Haig made it famous, but rather overdid it. Thirty-nine morbid states have been attributed to its irritating presence in excess. The normal quantity the urine should contain in excretion is from seven to ten grains, a ratio of about one to forty of urea. In many organs there is a capacity to destroy (or further metabolize) uric acid after it is formed and so we are ordinarily protected from too great an accumulation, but the origin and exact destiny of this end-product (or near-end-product) is not yet beyond controversy.

According to Howell's text-book on physiology (1908) the most recent teachings are: "Burian has shown that most of the endogenous purin nitrogen in the excreta results from metabolism in the muscular tissues. Increased muscular activity is followed within an hour or two by an increased output of uric acid, and under normal conditions the uric acid and other purin bases are derived mainly from a metabolism of the muscular substance whereby hypoxanthin is produced. This substance is then oxidized to uric acid and a part of the uric acid is further changed to

urea. About *one half* of the uric acid formed in man is converted into urea."

As it is the hobby of those who lack knowledge of physiologic means of stimulating the activity of metabolism to talk much of *purin-free* diet in uric acid states, let us note what the word *purin* means. From medical writings we might infer that purin and poison were Siamese twins, but the dictionary informs us that "purin is a compound *believed* to exist in the body but which *has not yet been discovered*." Emil Fischer coined the term "purin bodies" to cover a series of five chemically related substances with a common physiological significance. These nitrogen extractives from protein metabolism are uric acid, xanthin, hypoxanthin, adenin, and guanin. Red meats and the active principles of tea, coffee, and cocoa are the main sources of exogenous purin-forming material. Both the spleen and liver take part in the formation of uric acid.

The remedy for uric acid states and the diseases associated with them (gout, rheumatism, etc.) is not to be found in either drugs or diet so long as the functions of nature are not reinforced. The effective treatment must include elimination and the promotion of completed metabolism by the employment of rightly directed electric currents. They can be made remarkably *effective*. For physiology teaches that in excessive uric acid formation and deficient urea excretion we should apply our electrical stimulus to the vasomotor system to promote elimination by the skin and kidneys, to the regions of the liver and spleen to increase the metabolism in these purin-forming organs, and to the general body to increase the activity and completeness of tissue-metabolism. This is rational and scientific medical practice. An evasive diet is not.

The subject of *Trophic Nerves* is inseparably associated with nutrition. Nerves exercise a "trophic" or nutritive influence over the tissues and organs they supply. It is a familiar fact that muscles and organs waste and undergo degeneration when their nerve supply is injured or

diseased, and mere disuse even in health weakens and wastes a muscle. So we have so-called "trophic disturbances" going on here and there all over the body in every person who falls below normal nutritive activity of health.

Some sets of nerves increase the building-up stage of metabolism and their opposites lead to increase of formation of waste products. But no separate anatomical fibres exist for this special purpose. At least, none can be demonstrated. It is part of the general dominion of the nervous system over the whole organism.

Few realize, however, how dependent we are for many things upon our ability to *feel*. Pain warns us away from countless dangers, but how many readers know that our nerves of sensation are the great channels through which nature safeguards the nutritive repair of many tissues. On this point of exceeding interest the physiologist remarks:

"It is a striking fact that the most marked trophic disorders with which we are acquainted, are due to interference with sensory channels. Loss of sensation is the great predisposing cause of nutritive mischief."

Not only can we restore sensation when partly or even wholly lost in functional lesions, and thus correct nutritive mischief to the tissues, but even in organic diseases of nerves our command of electrical stimuli enables us to prevent the rapid failure of muscles and in some cases can cause a partial improvement. For every inch of the skin and its sensorial areas of reflex influence on the inner tissues are within reach of the physician and an electric current. We know from practice the great value of counter-irritation in promoting nutritional changes, and electricity is our chief remedy here.

Speaking of the skin, Kirke's Physiology remarks:

"It is important to remember the existence of skin *currents*, which are more evident the richer the portion of the skin is in secreting glands. The most satisfactory investigation of skin currents has been carried out by Waller. The

normal current of unexcited living skin is ingoing. The normal response of unexcited skin is outgoing. In a passive state any point on the surface is electro-positive to any point in the interior. But in the same mass when excited the interior chemical changes will be greater than on the surface, hence the internal points will become less negative, and therefore the current of action through the mass of skin is outgoing. Also, a contracted muscle is electro-positive to an uncontracted muscle."

So far we have said little about the *Spinal Cord*. It contains all the relay stations between the brain centres and the tissues, and is the distributing department of fibres and reflexes for the whole body. It is a wonderful mechanism.

And every inch and fraction of an inch of the cerebro-spinal surface of the body, from the cranium to the coccyx, is accessible to the application of an electric stimulus. To understand what this means in its bearing on about one-half of man's ill-health we must sweep the whole range of physiology.

In the sensory surface of the skin beneath our electrode lie the nerves of sensation and of reflex initiative; below the surface are the central cells and ganglia of the brain and cord; and near the surface pass out their fibres of distribution to all the tissues of the body. Our feeble pen cannot do justice to the opportunities for far-reaching good that await the application of rightly directed electric currents in this sphere of influence and responsive centres.

And this brings us to the final organ of the body, its great protective envelope and boundary of all functions, the *Skin*.

The saying that beauty is but skin deep is a superficial way to regard the remarkable covering that holds us together. And it is no mere wrap of external beauty, this cuticle of ours, for life without a skin is *unthinkable*.

We have only to reflect on the great organic functions of the skin; its vast area; its part in excretion and radiation of heat; its influence upon respiration and on heart pressure; its support of vessels, organs and muscles; its infinite

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network of capillaries and nerves, and through these its vital trophic influence and varied resources for the safeguarding of life and health, to realize that the concern and care of the skin merits our most serious attention instead of the customary neglect.

And electricity can be made to act as alterative, sedative, or tonic-stimulus to every fibre and function of this marvelous integument. By rightly directed treatment we can add tone to the cutaneous muscle-fibres and glands which are the very corner stone of its integrity; we can constrict or dilate its blood vessels and draw to the surface more blood when it needs it, or can lessen congestion and stasis by driving a local excess of blood away. We can increase its breathing capacity, regulate its function of perspiration, excite its reflexes, restore functional impairment of sensation, allay pain when sensation is too acute, feed it with trophic energies, heal many of its lesions, and tender it many comforts along the whole of life between the cradle and the grave. Even for the mere sake of beauty we can make electricity remove blemishes, clear the complexion, brighten the eye, bring color to the cheek, and send the glow of vigorous metabolism to the whole countenance of woman.

The importance of free and unobstructed capillary circulation is tremendously under-estimated by nearly everyone and cannot be over-estimated by any one. The whole vasomotor control and capillary system of the skin is accessible to the direct application of electricity. By right direction of dosage and method of use we have in electric currents the efficient means, not only of sedation, electrotonus stimulation and contraction, but we also command all degrees of irritant stimuli, from the faintest sensory excitation to rube-facient reddening, and from this to the production of vesication (if desired), or an almost instantaneous blister. And each degree of dosage and action is under exquisite control of the operator. The escharotic action of a high frequency arc leaves no scar.

If there were no other resources of electrical treatment than this single but brilliant action as an *irritant*, the effects of this one procedure can be made so far-reaching in influence upon both local and general deviations from normal function everywhere in the dominion of the cerebro-spinal nervous system and its reflex connections, that we could not entirely replace it in character and quality by any other resources of surgery or medicine.

But these useful things cannot be done with the common faradic toy. They require the suiting of means to end. And with twentieth-century means, what beautiful work it is! As we write these pages each essential tool and technique, manipulation, dosage, time and frequency of administration, the auxiliary measures of treatment, the combinations of effects required to meet the complex indications of chronic disease, the command of the full resources of modern medicine—these things spring instantly to mind in the consideration of each phase of our subject.

There is richly suggestive material in these chapters on *life phenomena*. Hitherto our knowledge of the medical possibilities of electric currents has been the slow outgrowth of individual experiences, widely separated and almost nullified in value by lack of unified study and a *central scientific system of research*.

But our next two chapters on the physiologic-medical properties of high frequency currents alone will show further that while individual experience may reveal to individuals the scattered facts of a lot of knowledge there results only a very small benefit to the general profession because the sum of discovered facts is not massed in sifted and systematic order and made known by systematic teaching to students of medicine.

Physicians who now want to acquire this ascertained knowledge must strive to do so over difficulties of study that none but a genius can surmount—and that only a resolute mind will undertake to surmount. This is all wrong. The situation should be very different. The facts should be

easily available in authoritative form and the entire medical profession should be as familiar with them as it must be with the related facts regarding other *materia medica*.

From a perusal of these twin gold mines of information—our three chapters on life phenomena and our two chapters on the physiologic-medical properties so far demonstrated with regard to high frequency currents—which it has cost the labor of Hercules to uncover, we get an inspiring hint of what might be accomplished in the determination of exact data by an endowed central laboratory of electro-medical *science*—with the ablest scientific investigators and the best and most complete sources of all electric currents and modes of administration applied to the task of *pursuing truth no matter where it leads*, and when the truth is found, publishing it *understandably* to the medical world.

Within ten years we should have the greatest revolution in the treatment of patients that has been witnessed since the age of bleeding. The gold mine exists, its wealth is known, humanity awaits, but *who will work it?*

Reviewed in the light of the practical experience of many years devoted to the treatment of patients with physical agents the future should hold the surety of still broader evolution in medical practice. With the increasing development of currents of high potential to which the small resistances of the skin (once formidable to currents of very low voltage) offer no more barrier to penetration than the skin of an apple does to a knife, our ability to utilize both direct and reflex electrical stimuli upon the central mechanism of the body has wonderfully increased.

The medical student who will simply take the teachings of his *materia medica* on counter-irritation alone and apply them in practice to the centres of the spine and the areas of the skin, using electricity as the swiftest and most potent and controllable “irritant” in medicine, will become acquainted with alterative and curative resources which he would not part with for any offset that could be offered.

There is more to physiology than is here included, but if

we have shown the reader how nature acts in the restoration of health, and made plain her guidance for our application of her remedies to the same end it is achievement enough. We shall next deal with the subject of high frequency currents and the physiologic-medical properties of the different forms of discharge. When we have ascertained what actions we can set up in given tissues by definite direction of these electrical tools (and how to do it) we will be ready to go ahead and treat patients. Do not fail to read with care the story of the next two chapters.

CHAPTER V

THE PHYSIOLOGIC-MEDICAL PROPERTIES OF HIGH FREQUENCY CURRENTS

Their Ascertained Actions Upon the Functions of Nerves, Organs, Glands, Heat Centres, Processes of Nutrition and Blood. Their Physiological Basis for Therapeutic Use. Effects on the Nervous System. Effects on the Circulatory System. Effects on Respiration and Intake of Oxygen. Effects on Elimination of Waste Products and Toxins.

WHAT is called scientific medicine now strives to build its therapy on the corner stone of physiology, so far as it is possible to lay this firm foundation. With many drugs it is difficult or impossible to do so, hence the complaint of empiricism against even the best practice of our day.

But *physical* remedies lend themselves to physiological investigation as naturally as a fish swims, and the medical properties of water, heat, mechanical vibration and massage, light rays, and electricity, which are the great physical agents of the *materia medica*, have been closely studied and their scope and *limitations* defined by scores of physiologists and clinicians—able men, men of the highest standing and authority.

Each of the four main currents of electricity has been especially studied until their actions upon the tissues are so thoroughly understood that they become instruments of precision in the skilled hands of experts. In this chapter we shall set forth these ascertained medical actions of high frequency currents, but first a word about electricity as a *cure*.

We are often asked the question, "What diseases will electricity cure?" There is no *drug* in the *materia medica*

which would permit a categorical reply—nor will electricity, or the surgeon's art. Taken as a whole, in all its various modifications of current, method, dosage, and responsiveness to skilled technique, electricity is by far the most broadly useful single therapeutic agent at the command of the medical profession, there being no one drug at all comparable in its scope of beneficial actions.

But, what is a cure? In Germany any building devoted to treatment in a health resort is a *Kurhaus* and the treatment given is a "cure," regardless of its result to the patient—whether he is benefited or not. But in this country a more discriminating language is employed, and our physicians speak of remedies and of treatment but do not call remedies cures.

Nor is a hospital or sanitarium with us called a *kurhaus* or *curehouse*. Indeed, wise men since Solomon have recognized the transitory state of things mundane and human; and a man may be costive to-day and have diarrhoea to-morrow, and is there aught in nature, drugs, diet, nuts, fruits or figs, that will surely cure the bowels of irregular habits and keep them "cured" till the heart stops?

We know of none. Salines, pills and fruits alike are temporizers. The only permanent cure for the changeful states of earth is that certain one of the wonderful lines of Webster—John Webster, the contemporary and the equal of Shakespeare in this dramatic expression of the idea:

"We cease to grieve, cease to be Fortune's slaves,
Nay, *cease to die*, by dying."

But high frequency currents from modern apparatus can help one over many of the rough places of life and iron out the wrinkles from many a troubled brain. The benefits they can be made to produce are as deep and lasting in effect as the best results of drug treatment or any other measures employed in their proper place, but we do not undertake to say in the pages of a book who, or what, will find in them a *cure*.

And now we are ready to take up the consideration of physiological actions. The treatment of patients by high frequency currents of electricity is based upon the power of these currents to *modify the physiological processes of nature within the body*, and the character and extent of these modifications are determined and confirmed by numerous scientific tests upon human beings under conditions of exact laboratory research.

Each physical agent, each current of electricity, is put to definite tests upon the nervous system, the circulatory system, the respiratory system, the secretory system, the excretory system, the cutaneous system, etc., and the actions which it is found can be established by each different method of administration and dosage, when fully tabulated and confirmed, pass into permanent medical literature as the "physiological actions" of the investigated remedy—and all the chief remedies of medical science have been thus investigated. The hasty reader who has assumed that the skilled administration of electricity was simply "guess-work" should remember this.

The capacity of high frequency currents to produce physiologic actions has been the subject of careful study for more than fifteen years, and a remedy that can endure the searchlight of fifteen years of investigation and retain the confidence of its investigators must possess substantial qualities of merit. In the past decade alone a hundred plans of treatment, both surgical and medical, have failed under such a test and been consigned to oblivion—but *electricity grows in usefulness the more it is studied and known*.

In order to select cases in which high frequency currents are competent to meet the therapeutic "indications" and therefore benefit the patient, it is necessary to understand broadly what actions they can be *made* to produce upon and within the human body. This study is so important that repetition will be instructive even at the sacrifice of a little space.

A scientific medical prescription is not the daughter of

Dame Chance. As a traveler at the doubtful turning of a road meets a signpost which *indicates* to him the proper way, so the physician at every turn of disease looks to the sign posts of *diagnosis* for his *indications* of the proper remedy. When he is able to interpret the signpost of the diagnosis which points him to the road to treatment he has then two problems before him: One is to decide what medical actions he should aim to set up in the body in order to restore the sound state of health, and the other is to select and administer the remedy that will enable him to cause the desired actions. When this is done successfully the physician attains the ideal of medical science—the definite meeting of indications with the remedy.

Going back to the writer's general text-book on the treatment of disease by electric currents, published in 1897, the following concise statement then presented its guidance to practitioners of that date:

“The physiological effects of currents of high potential and high frequency upon protoplasmic metabolism have been pretty thoroughly investigated and determined during the past five years. They are summarized by Apostoli as follows:

“Clinical tests upon more than a hundred patients show that these currents exert in the majority of cases a most powerful and generally beneficial action upon diseases which are due to a slackening of the nutrition, the benefits being produced by accelerating the organic changes and combustion. This is proved by the analyses of the urine made by Dr. Berlioz. The quantity becomes more normal. The products of waste are better eliminated. The increase of combustion is shown by the diminution of uric acid while the percentage of urea is generally increased. The relative proportions of these two substances change under treatment, so as to reach in general the ratio of 1 to 40. The elimination of the mineral products is also changed but in a manner less marked.

“When daily seances are given, each lasting fifteen minutes, we may generally observe in patients submitted to the influence of these currents the following modifications in



PLATE II.—Illustrating the general method of "Auto-Condensation," using an insulating seat on an ordinary chair. One terminal of current connects with seat, the other should be grounded. The high resistance of the seat acts as a "condenser," of which the person seated on it becomes a part. The entire body is thus charged with the current. The initial high voltage of the current at the transformer reduces to lower voltage as it accumulates to the capacity of the body undergoing treatment, about as the pressure of water running from a faucet reduces in the basin in which the water accumulates. A variation of method employs insulating pads as shown in Plate VIII. No sensation is felt during this treatment. It is essentially a sedative-tonic administration and is the high frequency equivalent of the static machine charge.

their general condition. We mention them in the usual order of their occurrence:

Return of sleep.

Increase of strength and vital energy.

Increase of gayety, of power for work, and ability to walk.

Improvement of appetite, digestion, etc.

General progressive improvement.

This general improvement often manifests itself after the first seance before any local influence is apparent, and before any change has occurred in the urinary secretions.

"Local pain and trophic changes are often more slowly affected by these general currents, and are at times entirely refractory for a longer or shorter period, and in such cases the same current must be applied *locally* at the seat of pain by contact with the electrode.

"The diseases which have appeared to derive most benefit from this therapeutic agent belong to the arthritic class; rheumatism, gout, and diabetes."

That compact and conservative memoranda was written twelve years ago by one of the most experienced French observers. Have the facts been refuted or sustained by time? Let us see. In 1904 the chief authority in England wrote the following note on the same subject:

"By a general application (in a 'condensation chair') we cause the body to be permeated with electricity at a potential of perhaps a million volts probably having about the same number of alternations per second. The effect of this has been proved experimentally by d'Arsonval, Marie, and many other observers, to increase the metabolism of the body, and incidentally to cure all those cases of neurasthenia which depend upon autotoxins for perversion of the nutritional functions of the tissues.

"By the local action we may obtain quite opposite effects upon the body, according to the method by which it is applied.

"We may produce a sedative action upon nerves and glands by applying the resonator current to the body through labile electrodes of metal or covered with moistened felt. We may exercise a stimulating effect upon nerves and

glands by the local application of the solenoid current by condenser electrodes, and especially by covering the electrode with a dry resistance, making the discharge an irritant.

"We may secure muscular contractions by placing the spark gap in the current derived from the two ends of the solenoid and applying it to the body of the patient through two moistened electrodes the same as a static induced current.

"Thus we can make high frequency currents increase metabolism,¹ allay sensibility, stimulate the sympathetic nervous system, increase or diminish the functions of glands, tone up muscular fibre, and act as a general tonic."

In 1904 one of the pioneer American physicians to investigate high frequency currents wrote an article which contained the following:

"These currents produce a general vitalizing and invigorating effect without undue stimulation. Speaking broadly, we have in them the closest approach to artificial vital force that has yet been produced.² Tissue combustion is increased in all parts of the body. The writer has made a large number of urinalyses and has found that these currents will oxidize uric acid into urea and increase elimination of waste products to a remarkable degree.

"Another universal effect of these currents is their strong tonic action on the vasomotor system, flushing the blood through the peripheral capillaries, opening the sweat glands, relieving local congestion, and causing a general sensation of warmth and well-being throughout the body of the patient. Notable effects in the line of tissue degeneration and in the alleviation of pain can be produced at will.

"In addition to these effects we can produce wonderful results by spray discharges along the spinal nerve centres, above the head with its brain centres, and over the solar plexus of nerves, the great abdominal brain.

"Again, by other variations in dosage and method of application we can cause powerful and painless muscular con-

¹ The word *metabolism* is used by physiologists to express the sum total of the chemical exchanges that occur in living tissues.

² Does the above author forget the "Frankenstein"?

tractions, at the same time producing the general vitalizing and invigorating effect which is a feature of currents of high potential. Modern improvements in apparatus enable the physician to now obtain all of the beneficial effects which may result from the use of faradic, the interrupted galvanic, the sinusoidal or the static machine currents, and in addition, to obtain the general systemic vitalization of the high frequency current."

Coming now to the corroborating researches of still nearer times we find so great a number of authorities reporting tests of earlier statements that merely to list their names would be tedious. But in their contributions to the medical press our American specialists generally include a physiological summary about as follows:

"Experiments have shown that the current from the large solenoid notably increases the respiratory exchanges, the excretion of the urinary solids including urea, uric and phosphoric acids, the toxicity of the urine, and the radiation of heat from the body. In other words, there is a decided increase in the general metabolism. When we consider the large number of affections now recognized as depending on or accompanied by defective or retarded catabolism, the physiologic data above given will readily indicate the therapeutic measures that may with confidence be pursued."

These are cumulative and confirmative evidences, far different from the damaging exposure that time reveals of the once dazzling claims of other remedies we can all of us recall—tuberculin, for instance. The reports of fifteen years establish the actions of high frequency currents upon as solid a basis as time has approved for the actions of quinine, a fact which should impress every medical man with an appreciation of their worth to his patients. Also, their worth to *him*.

Another American physician, one of abundant experience and authority, begins a very recent article in the Journal of the American Medical Association with the following "physiologic" résumé:

"In the high frequency current we have a nerve sedative of undoubted value, an electrical energy that tends to restore the normal equilibrium of disturbed metabolism, and, when delivered locally, can be intensified all the way from sedation up to a powerful irritant, but under perfect control.

"The sedative property of the high frequency current, its power to induce relaxation in conditions of nervous excitability, has long been recognized. This action is manifested in asthma, and on repeated occasions we have seen severe paroxysms subside quickly and completely after a few moments' application of this current.

"Its influence on metabolism is first shown by the loss of weight which patients invariably undergo during the first few treatments. In not one case in over a hundred that I have treated with this current have I failed to observe some early loss of weight. But after a varying period the appetite is stimulated, more food is consumed, and then an increase in weight is most certain to follow.

"Again this action is demonstrated by an increase in the volume of urine and its solids, the former being observed frequently and mentioned by the patients themselves.

"Locally (in treatment of exophthalmic goitre) the high frequency current undoubtedly stimulates the cellular activity of the thyroid gland, acting through an increase of its blood supply, as an erythema persisting for several hours is readily produced by effluviations over the thyroid.

"The sedative influence of the X-ray upon the rapid heart of exophthalmic goitre is most striking, and the high frequency current delivered through a glass vacuum electrode has a similar though considerably milder effect."

Finally, the conclusions of physiologists in demonstrating the effects of high frequency currents may be stated as follows:

On the Nervous System.—"General electrification" with an uninterrupted high frequency current within the range of medical dosage does not cause sensations or contract muscles.

General electrification has a sedative-tonic and calming influence upon the excitability of nerves. It has a marked

effect upon the sympathetic nervous system, results of which are seen in the vaso-dilation and contraction of blood-vessels during and after treatment, in the perspiration which ensues, in the response of glands, secretions, metabolism, and in other ways.

General electrification carries into the nervous system and imparts to it a renewal and increase of potential energy. It exerts a tonic influence upon the resources of vital energy stored in the cells and tissues of the body and supplied to them by food, by its electrical feeding and re-inforcing of the vitality of the nerves.

All other external remedies—water, motor vibrators, massage, all save the manifold adaptations of electricity—simply act upon nature's internal resources, often at a low ebb in severe illness, and make a demand upon the depleted fuel of the tissues and the weakened energies of the nerves. Electricity alone brings new fuel to the waning fires and re-inforces without reaction—stimulates without depression. In states of profound exhaustion in both acute and chronic diseases this *nutritional* trophic property is valuable beyond measure.

This trophic action enables the cells to absorb their nutriment from the blood, maintain their vital resistance and carry on their various functions. To supplement it and to strengthen it is one of the most important medical properties of electricity, notably associated with both galvanic and high frequency currents when exerted through a sufficient dosage.

Local electrification with an efficient dosage of high frequency current allays an over-excited sensibility of the nerve endings in the region of the application, and in practice will usually abate pain of almost every form, the permanency of the effect depending on the activity or removal of the causative condition.

Local electrification will stimulate a sluggish or depressed state of both voluntary and sympathetic nerves into normal excitability.

The tendency of high frequency electrification upon the whole nervous mechanism of the body is to seek a normal equilibrium when the nervous state is either exalted or depressed, as a "governor" steadies the pressure of an engine. Electricity cannot always accomplish this against every obstacle of disease, but it exerts the effort, and it is the part of the skilled physician to prescribe supporting measures to supplement its action and the patient will benefit in proportion as impeding barriers are removed.

On the Circulatory System.—Effects upon the blood-vessels vary according to the dosage and method of administration. With general electrification there is a fairly constant rise in arterial tension during treatment and a fall in blood-pressure some little time after treatment.

Applications of the glass vacuum-tube discharge increase the blood supply in the parts treated. A stable application upon a local congestion will remove the stasis and cause an active flow through the vessels of the part. A powerful revulsive action may be obtained when desired, as upon the chest in bronchitis, by the same labile application made sufficiently irritant by regulating the dry resistance over the tissues. These actions are of great clinical importance.

Locally, the high frequency spark discharge causes an instantaneous vasomotor constriction, blanching the skin in a spot like a wheal, which is soon followed by dilatation of the capillaries and redness of the spot. The first spark is acutely felt, but with a properly dosed discharge the subsequent sensation is partially dulled. Unless the spark is suitably dosed a fusillade directed upon a single spot will be intolerable. The quality of the spark varies greatly in differently constructed apparatus and may be either soft and scarcely felt, or as sharp as a red hot needle stab.

The spray has a very different action. "By means of the brush discharge a very considerable increase in blood-pressure can be produced. Moutier, by a downward application on the spine of a man, was able to demonstrate a rise of

pressure of 4 to 8 centimetres of mercury. Doumer confirms this result. Denoyés states that arterial tension can be more rapidly raised by this procedure than by any other method in use at present, not excluding the transfusion of artificial serum. Oudin has increased the arterial tension in an anæmic subject as much as 9 to 14 centimetres during a single sitting. Reus, Crooneg, and Leduc have reported a similar rise in blood-pressure after applications of the high frequency spray.

"Dr. Oudin has examined the tracings of the capillary pulse with a sphygmomanometer and found that when the spray discharge touched any part of the body it instantly produced a spasmodic vasomotor contraction in the capillaries of the hand, producing a marked decline of the general curve.

"He has also proved that a diminution of the amplitude of pulsation takes place, in some cases almost amounting to complete suppression. After treatment the pulse rapidly resumes its former character, but only regains its amplitude after a considerable period, during which the tracing records a progressively decreasing series of vasomotor oscillations.

"Doumer and Oudin therefore recommend this treatment in diseases characterized by diminished activity in the nutritive changes and in chronic local inflammations due to arterial or venous stasis."

Local applications may be made to set up the reflex actions of both sedatives and irritants, depending on the method and conditions, there being no other resource of counter-irritation so convenient, so controllable, so swift in action, and so competent to do exactly the work required without by-effects on the skin, vesication, or annoyance to the patient. It far surpasses plasters and blisters. In this field of action it is unique, if skilfully used. All medical students of counter-irritation can realize the scope and value of this property alone. Part of the tonic benefit of high frequency currents to the heart is reflex action.

Much has been written on the value of high frequency currents in combating the advance of arterio-sclerosis, and this requires us to consider at some length another and im-

portant phase of the circulatory influence of this agent; namely, the modifications of the blood itself induced by electrification. This will be better understood, however, if we first describe the effects on two other functions which intimately concern and react upon the quality of the blood in both arterial and venous systems. These are the effects upon respiration and elimination.

Effects on Respiration:—When a person is subjected to a general electrification with currents of high frequency and tension, there is almost always an immediate tendency to take a full and deep breath, relax the body, and during the séance to breathe with more than ordinary satisfaction. This tendency is more marked in some individuals than in others, and also depends upon the dosage of current used.

General electrification induces an increase in the number and depth of respirations, both in man and the lower animals, as demonstrated by graphic tracings by a recording lever upon the instrument of Marey.

There is an increased activity in the processes of respiratory combustion and in the amount of respiratory work done. In a fixed unit of time there is a considerable increase in the amount of oxygen absorbed and in the carbonic acid gas eliminated. Proofs of the greater rapidity in respiratory exchanges are also afforded by the loss of body weight under prolonged electrification, and by the findings of urinalyses.

In experiments upon himself d'Arsonval found that the quantity of carbonic acid gas excreted rose from 17 to 37 litres per hour. He also found that a guinea pig electrified for sixteen hours under exact laboratory conditions with possibilities of error eliminated, lost 30 grammes as against a loss of 6 grammes under the same conditions without electrification.

Baedecker reported experiments and showed that the respiratory quantity increased in seven minutes of electrification from 6,140 to 11,600 c.c. per minute. All the figures reduced within five minutes after treatment and in fifteen

minutes respiration became normal again. In tests upon eight men made by two other investigators it was found that the consumption of oxygen increased over the physiological limit of 6%, in one case the increase amounting to 12%, in another to 19%, and in two other cases to 6%. Tripet's observations on the activity of exchanges in internal respiration will be noted in our remarks on the alterations which take place in the state of the blood.

The effects of *local* applications of high frequency currents on respiration have been demonstrated by many observers and are not questioned by any.

The spray discharge upon the spinal centres stimulates them and considerably increases the activity of the respiratory centres, so that respirations become both deeper and quicker, while at the same time more respiratory work is done.

The spray discharge upon the thorax, on the contrary, causes quickened and shallow breathing, alternating with slow and deep respirations, with an occasional pause in expiration.

The spray discharge upon the abdomen, especially on the epigastrium, induces very rapid respiratory movements at the beginning of treatment, followed by a slowing of the movements which becomes more marked the longer the application is continued, the pause between movements occurring at full inspiration.

Effects on Elimination:—General electrification with an efficient high frequency current influences the amount of urine excreted, increases the elimination of nitrogenous products and the toxicity of the urine, reduces the amount of uric acid contained in the urine of patients suffering from rheumatism by converting it into an increased elimination of urea, causes an increase in the oxyhæmoglobin of the blood, and in general not only stimulates the desire for work by improving the nutrition but by the same means furnishes the energy necessary to sustain it.

The original statements of d'Arsonval in reporting his

exhaustive experiments on these actions have been supported by a great number of independent investigators. In cases tested by Lacailli the quantity of urea present in the urine rose steadily under electrification from 11 to 43 and even to 60 grammes. Berlioz made 761 chemical analyses of the urine of 280 patients treated by general electrification with daily sittings averaging fifteen minutes. Collateral influences of medication and special diet were excluded and the action of the current was studied. The results were:

An improvement in diureses and in the elimination of excrementitious waste.

A considerable increase in the process of organic combustion.

An increased conversion of uric acid into urea and a reduction of their ratio to normal when there was an excess of acidity.

A number of additional pages could be filled with reports of elaborate tests made by different observers upon groups of persons during the past ten years but it is sufficient to say that they closely agree with what is stated above. Our next chapter will show the effects upon the blood and heart.

CHAPTER VI

THE PHYSIOLOGIC-MEDICAL PROPERTIES OF HIGH FREQUENCY CURRENTS (concluded)

Effects on the Blood. Increase of Hæmoglobin and Cells. Effects on Oxidation and Combustion. On the Heart and Blood-Pressure. On the Lymphatic and Absorbent System. Effects on Secretions of Glands and Mucous Membranes. Effects on Muscular System. Effects on the Skin. On Heat Production and Body Temperature. Deep Penetration of High Frequency Currents. Effects on Retino-Cerebral Mechanism. On Micro-Organisms. The Antiseptic Action of Ozone in High Frequency Discharges.

Effects on the Blood:—Dr. Curtis states: "I believe that the person who has pure blood is immune to disease." The cells of pure blood are robust, noticeably free and vigorous in appearance in the micro-photograph of freshly drawn specimens. In a diseased state the individual cells cease to be independent, and adhere to one another, and morbid products are shown in the microscopic examination. In anæmic states and in suppurative conditions the restoration of the normal attributes of the blood is of the first importance.

The direct primary effect of a high frequency current upon the constituent qualities of the blood is only produced by a form of discharge and application which will alter the oxygen of the air into an allotropic and more active form, to-wit: *ozone*, and by the cataphoric conduction of this antiseptic gas into the tissues and the circulation. This being readily done and demonstrated by certain tests, an alterative result follows which has been investigated by a number of physicians, among them Curtis, and Watkins.

Examinations by the wet method of many cases conducted during a period of six years showed, according to

these authorities, the effect of high frequency ozonation to be as follows:

"In chronic cases treatment with the high frequency current causes an increase in the number of red blood cells at the rate of about one million per month, while the white cells diminish in number at the rate of about eight thousand in the same period. In acute cases the rate of increase is much greater.

"After the ratio of white to red and the number of red is restored to normal the cells gradually regain their original form and vitality. As a result of the action of the ozone-current in destroying the *materies morbi* in the blood the processes of assimilation, nutrition and innervation are re-established and the constituent qualities of the blood regain their normal state."

In another place we shall speak further of this property of the high frequency current and cite cases to illustrate the results of treatment. The subject possesses the greatest interest in a wide range of diseases, especially those affecting the respiratory organs—and of these we have upwards of three million cases a year in the United States.

Tripet investigated the exchanges in the blood and tissues, making his examinations of the blood by means of Henocque's hæmatospectroscope, before, during, and after high frequency treatments. He reported results as follows:

In thirty-seven cases electrification increased the activity of reduction of oxyhæmoglobin. This was particularly manifested in cases with poor nutrition.

In ten cases of diabetes, in which the activity of reduction was greatly increased before treatment the high frequency current reduced it to within normal limits.

It was only in cases of advanced organic degeneration—six out of Tripet's fifty-three cases—that electrification was without effect.

"It is remarkable that there is almost always a simultaneous and parallel increase in the proportion of oxyhæmoglobin and that of the activity of the reduction, this increase

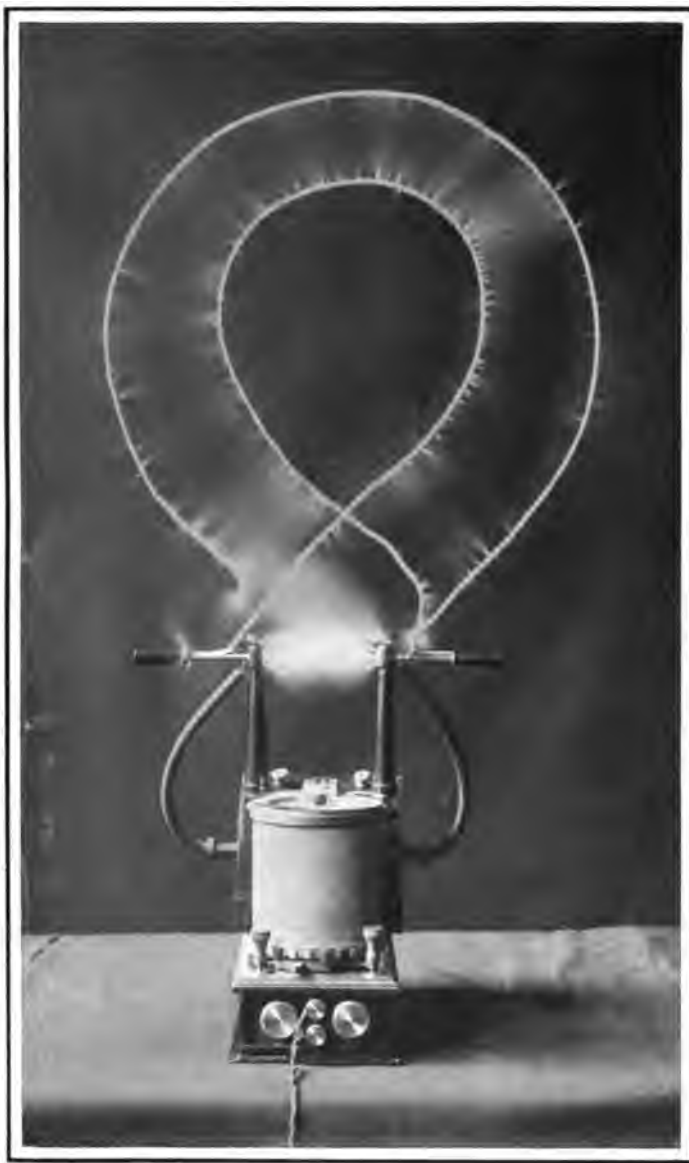


PLATE III.—Compare this medical high frequency apparatus with the model in Plate II. With the primary and secondary circuits in resonance a remarkable display (as illustrated) can be produced by a very small expenditure of energy. During the inventor's laboratory experiments discharges covering an area of three square feet were produced by a total energy of 25 watts from a 110 volt circuit. The high frequency current is a wonderful, many-sided, potent and flexible ally of the healing art, as will appear in every chapter of this book.

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of oxyhæmoglobin being largely instrumental in determining the activity of reduction. This increased absorption of oxygen, the respiratory essential of life, is accepted by all observers as an effect of high frequency electrification. We know of none who deny it.

"Guillaume also, by the same method, determined the effects upon the activity of reduction of oxyhæmoglobin in diseases characterized by malnutrition, as anæmia, chlorosis, rheumatism, sciatica, gout, etc. His conclusions were the same. In all cases of relief to the principal symptoms there was noted a modification in the reduction of oxyhæmoglobin. The increased activity of reduction was always accompanied by a similar increase in the amount of oxyhæmoglobin, thus proving that the improvement in general health was brought about by the increased nutritional activity of exchange between the tissues and the blood."

As it is the red-cell pigment, *hæmoglobin*, which collects the respired oxygen from the lungs, carries it through the blood to all the tissues in the form of *oxyhæmoglobin* which is given off to the tissues and furnishes the means of oxidation, it is obvious that high frequency currents add an important food-process to their primary electrical action; and this nutritional influence which is common to the higher types of current in a greater or less degree, is one of the most prized attributes of electricity in the treatment of disease.

Effects on Oxidation and Combustion.—The living human engine is run by food-fuels which are converted into heat and force—the same as coal—by combustion with oxygen; to-wit: *oxidation*.

Too little fuel, or too little oxygen, or imperfect combination, results in deficient or incomplete combustion. In the latter case the fuel is not burned to ashes for proper elimination but leaves clinkers in the system as unconsumed coal-clinkers clog a grate. Most chronic diseases (but especially those of the rheumatic type) pester a patient with an element of this sub-oxidation.

High frequency electrification, in proportion to the en-

ergy of dosage, combines three important actions upon this process.

It increases appetite and relish for food, inducing an increased intake by improving the completeness of digestion.

It increases the amount of oxygen taken into the lungs by improving the function of respiration.

It then also increases the delivery of this oxygen throughout the tissues.

The result of this increased intake and exchange of oxygen is the same as an increase of fuel and draught to a fire. Deficient combustion is roused to completeness, and the ashes of waste are refined to the physiological degree. This disposes of the uric acid "clinkers" and unburned irritants in the system. In thus promoting oxidation high frequency currents exert a very complex and far-reaching influence upon the general health.

On the Heart and Blood-Pressure:—Sloan's¹ reports of his investigations in the London Lancet, June, 1907, are so extensive that they occupy the space of nearly half this book. They cover one year of physiological research on the actions of high frequency currents on the cardio-vascular, thermo-genic, gastro-intestinal, and renal systems. The report is illustrated with tables, chart records, and an extraordinary amount of detail to support his findings. It is almost impossible to condense for extract but we offer the following as part of what he says on blood-pressure.

"I have reason to dispute the statement that these currents always, after a therapeutic dose, cause the blood pressure to fall. They frequently, indeed, do the very reverse, and with great advantage to the patient. If the heart's energy is only slightly diminished it will maintain the blood pressure at its initial height by virtue of the tonic effect of the current upon it, if the dose has not been so

¹ Dr. Samuel Sloan, M.D., Glasgow, F.F.P.S., Consulting Physician, Glasgow Maternity Hospital; Consulting Physician, Glasgow Hospital for Women; Examiner for Triple Qualification, Glasgow and Edinburgh; Formerly Examiner, Glasgow University, etc.

strong as to cause an excessive relaxation of the arterioles. The increase in heart force exactly counterbalances the reduced arteriolar resistance. Should the arteriolar relaxation be excessive the blood pressure may rise, but only if the current is suited to the case and if the heart force is increased at a greater rate than the peripheral resistance has been reduced. It is to be noted that all possible combinations of increase of heart force and decrease of surface resistance result in an increase of blood-flow.

"The conclusions reached as the result of tests upon patients are:

"1. These currents cause at first, in all cases, diminished peripheral resistance.

"2. In all cases this is followed sooner or later by increased cardiac force when the currents are given in therapeutic doses.

"3. The effects on the blood-pressure and the pulse-rate of this double action will depend on the cardio-vascular *stability*.

"4. Should this be normal there may be no change whatever save an increase in blood flow giving rise to a slight elevation of the temperature of the blood.

"5. Should there be slight cardiac instability the heart only partly compensates for the lessened surface resistance and hence the blood pressure falls slightly with no change in the pulse-rate.

"6. Should the heart be weak, the blood-pressure already low on this account, and the patient in a state of rest before treatment, the increase of heart force obtained from the current may so overpower the tendency to peripheral relaxation that the blood pressure rises while the pulse-rate falls.

"7. Should the state be the same as in 6 except that the patient has been recently fatigued or unduly excited, then the heart may be unable to respond to an active and sudden stimulation by the current. If the heart in such a state fails to respond and is staggered, the blood pressure will alarmingly fall, with a relatively high pulse rate.

"8. If the state is between 7 and 6 there will be no decided fall in blood pressure but the patient will feel a moderate sense of fatigue after the treatment and in such a case a stimulant may be given and the after effect will be tonic.

9. In states of low blood-pressure, such as 6, 7, and 8, due to weak heart, the after effect of treatment with high frequency electrification is a higher level of blood pressure.

10. If the blood pressure is already high, as from high arterial resistance with diminished heart force in albuminuria, the current will have the effect of raising the blood pressure without raising the pulse-rate. Where the above is the case, and from long illness the heart is markedly weak, as shown by a rapid pulse which no medicine is able to reduce, the beneficial effect of the current on the pulse is sometimes striking.

11. When the blood pressure is high for the individual's age and there is no apparent disease to account for it, I have observed that after several applications of the current the blood pressure is diminished and there is a corresponding improvement in the pulse-rate.

"Upon *rhythm* the effects of electrification are marked. In some instances of intermittent pulse—radial only, or cardiac as well—the intermissions will diminish or disappear, even in a case which had caused anxiety to the patient for many years. If the intermissions are recent, as from temporary digestive disturbance, they may cease after only two or three electrifications, along with the associated benefit of the current on the gastro-intestinal canal.

"When the pulse is variable before electrification it may become quite regular and steady immediately after.

"In making exact researches of this kind some confusion in judging of the influence of the current on blood pressure may arise unless care is taken to eliminate the effects of preceding exertion or excitement just before tests are made. Sufficient time to calm the circulation and restore the cardio-vascular *status quo* must be allowed just before treatment in order to arrive at reliable conclusions. This has been done throughout my researches.

"If a rise in blood pressure and a fall in pulse rate result from previous exertion, a fairly good dose of current may be given, the final effect being probably a lower pulse-rate with no change in blood-pressure. But if slight exertion results in rapid pulse with the blood-pressure not high, danger may follow even a moderate dose of current for an extended treatment and the time should be materially shortened.

"Should the pulse rise as soon as the current is turned on the patient may note slight faintness towards the end of electrification, there being a delay of a few minutes in the increase of the heart force by the current. The tonic effect on the heart will appear later by the fall in the pulse-rate and the rise in the blood-pressure.

"These researches offer sufficient evidence to establish my contention as to the tonic effects of high frequency currents on the heart, a subject which is of the greatest importance."

Effects on Lymphatic and Absorbent System:—The general administration of high frequency currents promotes the functional processes of lymph vessels and absorbents. Local applications stimulate them more actively. The tendency of the current is to restore normal action when the functions are depressed, remove stasis, promote absorption of infiltrated fluids, reduce glands which are enlarged, and abate pain if it exists.

On Secretion of Glands and Mucous Membranes:—The tendency of general electrification with a high frequency current is to regulate the secretions of glandular organs to normal.

The direct local application of an ozone spray discharge rapidly dries an excessive serous secretion, as in an acute coryza, and less rapidly reduces a pathological production of mucus, and also, pus. It is this action which contributes to the rapid and easy cure of hay fever, and which does so much to clear of exudates the half-drowned air passages in pulmonary tuberculosis. It is brilliantly effective in bronchitis. *It has a score of uses.* Coleman reminds us that mucus, wherever found, is a culture medium for bacteria, and a means of controlling every excessive secretion of mucus to which this spray can be directly applied is a great contribution to medicine. Yet it is but one of the complex and manifold advantages of electricity for all physicians to employ.

Both general and local applications of high frequency currents tend to stimulate to normal the secretions and excre-

tions of glands and glandular organs when these are depressed below normal. An example is seen in the action on the kidneys. Other examples occur in cases with dry mouths and throats, especially marked in phthisis with temperature. A local application with the glass vacuum electrode speedily starts up the action of the salivary glands and the mouth moistens agreeably. On the breast of a nursing mother we have demonstrated the stimulation of the secretion of milk.

Another example, universally witnessed, is the stimulation of the sweat glands of the skin. Medical treatment deals only with therapeutic dosage but as a sheer demonstration of this power, it is possible with a very heavy current, to bathe the person of an experimenter in three minutes in as copious a sweat as he would exhibit in twenty minutes in a Turkish bath. This has been done, but regular medical apparatus is not constructed to yield so heavy a current for the reason that such demonstrations impose an excessive tax on the system and if repeated will work injury.

Effects on Muscular System:—Apparatus used by all early investigators and still used by physicians who have not kept pace with improvements, supplied only high frequency discharges without facilities for contracting muscles. The great importance of muscular contractility in physiology and in maintaining normal functions, as well as the need of a means of treating cases of paralysis with this agent, has led American manufacturers to add devices which permit the adjustment of dosage and the interruption of the current so as to cover a great part of the work familiar to the best faradic battery and the static induced currents. This is a most valuable advance. The all-important physiology of *exercise* is thus brought within the province of high frequency treatment and rounds out the usefulness of this remedy in a most essential respect.

Effects on the Skin:—General electrification produces no direct action on the skin.

The *local* effects of the spark, spray and vacuum-tube dis-



PLATE IV.—Illustrating an application of high frequency current to the breast of a nursing mother to stimulate an increased supply of milk, as this current will stimulate all natural secretions of the body when they fall below normal functionation. With a gently stimulating dosage, move the electrode slowly over the gland throughout its entire surface. The increased tonicity can be immediately felt, as originally reported by the author in the *New York State Medical Journal*. It is of exceeding interest in suitable cases when ordinary galactagogues have no effect.

charge vary according to the intensity of the dosage and extent of the administration. A soft, thick, mild spark, such as ripples from a condenser electrode with a Piffard transformer, is a stimulating, non-irritating, antiseptic, discharge; healing to a number of conditions. The sharp thin spark from a ball electrode or dull point, with the usual coil apparatus, is a swift irritant which can be carried to inflammation and a cautery effect under proper conditions. These actions may be seen in the destruction of a wart by a single application of sparks. The vaso-constriction and subsequent vaso-dilation of the capillaries in a wheal-like spot which is the first step in the action of the spark, can be seen in any application on the normal skin anywhere.

The actions of the vacuum tube and spray discharges in their milder dosage induce a warmth in the skin by increasing the capillary circulation. In proportion as the intensity of dosage is increased this merges into a rubefacient effect, which can be made as strongly irritant as desired. Skin specialists have made a great deal of use of high frequency currents, as may be noted in our other chapters.

As the majority of American dermatologists, following the lead of one of their number, have purchased an high frequency apparatus of limited range of dosage, they have used this current simply as a superficial sedative or stimulant or escharotic, rather than for deeper constitutional effects. The vacuum-tube discharge affords them all grades of superficial irritation whereby the local heat and blood supply is increased, creating a substitutive inflammation when necessary, regenerating the nutrition, promoting absorption of effete material, and favoring the repair of a variety of local lesions. The escharotic effect of the spark is useful for the destruction of warts, moles, nævi, and similar small blemishes on the skin.

On Heat Production:—Among the most important results of the chemical processes which we sum up under the term metabolism, is the production of animal heat. As high frequency electrification increases the activity of the proc-

esses of metabolism which generate the heat in the body it was early assumed that there was an actual increase of heat production under its influence. By means of the anemocalorimeter d'Arsonval was able to determine the difference in the amount of heat given off by a person in its interior, both before and after general electrification.

He found that the amount of difference varied from 79.6 to 127.4 calories per hour, at a mean external temperature of 17° C. This amount does not represent more than 80% of the increased heat production caused by the current.

As the balance of normal temperature in the body is maintained by variations in heat production and heat loss under the control of a nervous thermogenic mechanism, the thermometer does not, ordinarily, show any rise in temperature as the result of electrification. In certain toxic febrile conditions with persistently dry skin there may be a rise of one to three degrees F., followed by a reduction to nearer normal than before treatment. This gradually regulates to normal in proportion as the elimination of toxins and the activity of the sweat glands can be promoted by the current. It is a study of great interest to the clinician.

One of the marked and gratifying effects of high frequency applications is their warming action upon cold states of the body, especially in patients suffering from the cold extremities of disturbed circulation and capillary anæmia. The restoration of normal comfort is exceedingly agreeable. The cold hands and feet of the habitually clogged liver are an exception to this rule and to make the effect of electrification lasting the liver must be treated and regulated by additional means.

Sloan's researches into heat effects fill nearly four columns in the *Lancet*. His main points are: "Surface heat production by high frequency electrification is physical rather than physiological. To be accurate tests upon patients must allow sufficient time for the distribution of heat to the rest and recumbency of the subject. After certain control experiments he found that while some of the rise of

temperature in the mouth and rectum must be electro-physiological, yet the greater part of the transfer of heat from the internal to the peripheral circulation is natural and not caused by the current. An accurate test requires from thirty to forty minutes' time.

The increased surface temperatures determined by Somerville are directly proportioned to the square of the current. The heat is the product of resistance (measured by the difference of potential) into the square of the current, and the greatest local heat is always nearest the place of contact with the electrodes. It should be remembered that in electrification with a static-machine current the quantity of electricity condensed in the patient is proportioned only to the capacity of the entire body, all parts of it being charged alike: whereas, in high frequency electrification the charge decreases in proportion to the distance from the electrode-contacts.

On Penetration of High Frequency Currents into the Deeper Tissues:—Scarcely any one now needs to be reminded that the idea of 1806 that electricity acted only on the surface of the body was shown to be an error in 1842. It requires a great deal of ignorance to now question that any electric current can be made to penetrate the freely conducting internal tissues of the body, and only extreme density of prejudice can be imagined as denying that currents of such high potential as we now employ penetrate everywhere. In fact, it is almost impossible to insulate them. They will act through two inches of plate glass.

But Sloan patiently investigated this subject and offers the following test to those who wish to convince themselves that high frequency currents traverse the neuro-muscular apparatus: "With one hand holding one of the usual couch electrodes, place another electrode held by an insulated handle on the upper portion of the sterno-mastoid muscle, inserting a small spark-gap in the path of this electrode, and he will have sensible demonstration of the fact."

In our own practice we can demonstrate the penetration

of high potential currents so readily and in so many ways that it needs no argument whatever. In speaking of his tests for differences of potential in different parts of the body Sloan remarks: "The resistance between the mouth and the rectum is not that via the surface—the chin, neck, breast and abdominal walls; but that of the gastro-intestinal tract which is five times less. Since the current is thus seen acting on the whole lining membrane of the alimentary canal there is no wonder that this electric energy has an influence on the appetite and on the general health."

On Retino-Cerebral Mechanism.—Sloan's researches here possess a novel interest. After referring to his investigations of four great functional systems he observes: "Can any of these, or all of them put together, explain the various signs and symptoms we know to expect from this treatment? I am sure they cannot. They give no explanation of certain sensations remarked by patients after auto-condensation treatment.

One patient will say that the after-effect is a comfortable weariness in contrast to fatigue or faintness. Another will say, "I feel for an hour or two after it a restful weariness which is just lovely." One lady after the vacuum electrode had been applied to the supra-orbital region for neuralgia, remarked the following day, "I don't know what you have done to me or how you have done it, but since yesterday a load has been lifted from my mind and all my cares are gone." I knew she had cause for much care yet on her subsequent visits and until I last saw her she declared that her mental distress had not returned.

"These indicate that some action on the central nervous system takes place under the influence of the current. To attempt to measure this I made a series of studies of the after-image on the retina, the duration of which gives us some indication of the condition of the retino-cerebral mechanism."

The length of these observations and the impossibility of condensing them for intelligent extract, permit us only to

say that apart from noting the favorable effects of the current during his tests he arrived at no new conclusions.

On Micro-Organisms:—General electrification with a high frequency current (in a small medical dosage) has a limited effect in modifying the virulence of toxins produced by micro-organisms. A great deal of experimental work has been done to ascertain the effects, and at this date we may conclude that the direct primary influence of this attenuated method is practically negligible in the treatment of disease. Improved nutritive processes and increased tissue-resistance resulting from the current enable nature to do far more in combating bacteria than is done by any primary germicidal action of so *diffuse* an administration of electricity. But a *concentrated* local discharge is a different matter.

“About all common forms of germs have been subjected to experiment with *local* high frequency discharges, including those of anthrax, typhus, typhoid, tubercle, gonorrhoea, diphtheria, and favus.

“The intensely localized spark discharge destroys the colonies on which it is directed but has no effect upon surrounding colonies.

“The effective antiseptic application is the spray discharge with its germicidal admixture of ozone. A small current yielding a thin spray will render a culture sterile in thirty or more minutes and the effect increases with the dosage. A current of vigorous density, yielding a thick brush discharge, with the electrode held properly near the surface treated, and especially if the culture is grounded, will speedily hinder the development of colonies and in a few minutes utterly destroy them.”

The clinical value of this action is admirably shown in applying such an electrical ozone spray to a fetid ulcer. The odor ceases, pus dries, its formation lessens, pain and tenderness abate, and healing by granulation goes rapidly forward.

As regards the antiseptic action of nascent ozone gas, an

English surgeon contributes an article to the *Lancet*, from which we extract the following:

"The views that I have so often expressed are:

1. Micro-organisms that are, under healthy conditions, good and useful, will become hostile under unhealthy conditions.

2. Unhealthy micro-organisms require unwholesome matter for their nourishment.

3. Ozone and oxygen act by so changing and purifying purulent discharges that unhealthy micro-organisms, being deprived of the nutriment necessary for their existence, decrease and finally disappear.

4. Ozone and oxygen have this effect on every micro-organism I have ever been able to discover in wounds or suppurating surfaces, except the staphylococci, which, under these conditions increase in number and often in size, their increase then being a clear indication of healing and a good prognosis.

5. Ozone is a much more powerful agent than oxygen.

These conclusions are the result of observations and microscopical examinations of the pus of 500 cases treated with oxygen and ozone during the past twelve years, and close study of the subject."

A scientific publication which conveys its facts in "plain English" for popular reading explains the destruction of bacteria by ozone in a way that everybody can understand. There are doubtless 150,000 physicians in the United States and Canada who have not yet encountered this knowledge, and for their benefit we append it. Though it refers to killing germs in drinking water it equally well explains the action of ozone on germs in the watery solutions of the body, the principle being the same although the smaller dosage of current used in treatment diminishes the destructive energy. Our extract is taken from the issue of January, 1909.

"The ordinary 110 volt alternating current is stepped up to about 8,000 volts which, in the ozonizer box, produces

a silent discharge and converts the oxygen of the air into ozone. The water and the ozone commingle, the ozone in its millions of minute bubbles coming into intimate contact with every particle of the water and completely destroying all the disease-producing bacteria contained therein.

"The reason for the destruction of the bacteria by the ozone is this: Chemical analysis of the bodies of bacteria shows that they are made up of about 84 per cent of water and 16 per cent of solids. Of these solids more than half is made up of carbon.

"The strong affinity of *oxygen* for *carbon* is well known. Ozone, being a concentrated form of oxygen, has a still greater affinity for carbon, and the moment a bacillus comes in contact with a bubble of ozonized air the carbon of its body combines with oxygen and the bacillus is consumed as completely as if touched with flame."

This necessarily abbreviated account of the actions of high frequency currents cannot tell the whole story. In practice we find many beautiful uses for this agent, here but little hinted at or not at all set forth. It is a remedy of exquisite properties, attractive simplicity, and brilliant accomplishments.

If any interested physician who has read this chapter will now take his *materia medica* and compare the physiological actions of our main drug remedies, iron, arsenic, aconite, belladonna, mercury, quinine, strychnine, digitalis, iodine, etc., we think an impartial mind must reach the conclusion that high frequency currents join friendly hands with all other measures, as allies that will bridge many an unfilled gap in internal prescriptions, and which should be in daily use with the great majority of practitioners.

If any doubt about the value of this agent in medicine still exists in the mind of any reader let him once put its actions to the test of experience and he will inevitably be convinced.

We will next take up the subject of clinical work with high frequency currents during the past ten years and show what has been accomplished by those who use them.

PART II

World-Wide Clinical Experience Collected Into Compact Testimony

CHAPTER VII

TO KNOW OR NOT TO KNOW

A Little Chapter of Great Significance. The Application of the Fable, and Some Additional Facts. The Conclusions of a Renowned Investigator.

THE Fable at the beginning of this book will be understood at sight by the initiated and the author's students. It exactly expresses the attitude of mind displayed by most of the world (and the bulk of the medical profession) towards scientific electrical knowledge and electrical instruments of therapeutic precision. The way in which electricity is most commonly "tried" is like the fumbings of clumsy paws upon the strings of Apollo's lute.

For all the generations since Remak and Duchenne laid many of the foundation-stones of modern scientific medical electricity by their studies of physiological actions, a curious three-cornered situation has existed. Two sets of investigators have worked apart with little joining of their results, while a third set (which includes almost everybody) has shut the workers from their ken and voted with one voice that only *Ignorance* is in sight. The *Knowledge* they have set their face against knowing they declare does not exist.

Some of the keenest research of modern physiologists has elucidated the relation of electric currents to life phenomena, and a wealth of knowledge has been mined in the chief laboratories of science and education.

On the other hand a few progressive physicians during each period of advance have made themselves expert in some of the technics and methods of medical electricity, have studied improvements in apparatus, and contributed

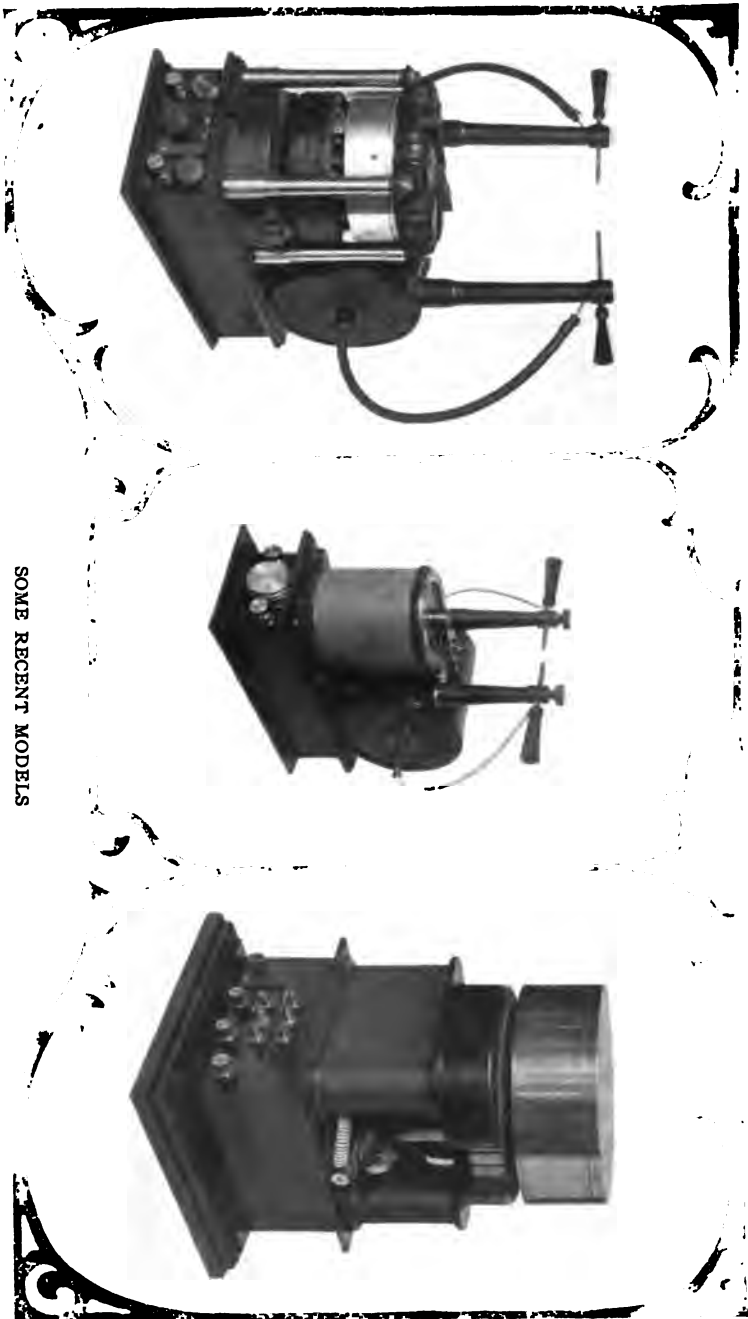
their experience to the sum of printed knowledge available for other physicians. But the studies of physiologists (of incalculable value) have not been closely joined to the experience of physicians for the reason that each branch of research has its separate journals and text-books, and medical workers rarely learn of the revelations of the laboratory that would help them to treat patients better.

The chief interests in the medical profession have hitherto led the third great class in relation to prescribing electric currents. Habitually averse to electricity in medicine, acquiring scant useful knowledge of it in medical schools, gleaning no knowledge whatever of the illuminating facts of electro-physiology, giving no study to special journals and text-books on the subject in either branch of work, and influenced by inherited traditions of prejudice and the great weight of vested commercial interests in drug-making, drug-selling and drug-teaching, the strongest body of medical leadership has taken the stand of the animals in the fable and declared that electric currents are not remedial agents of the *materia medica* and that use of them is quackery.

A few of the eminent however maintain that while electric currents themselves "have no action upon the tissues of the body, yet the apparatus generating the current is *impressive* and hence can be the means of impressing patients with some vague and imaginary benefits through the medium of *suggestion*—but has no serious value."

That the above opinion is unsound (and mere assertion) in the face of contrary facts is indisputable. Those who deprive others of the greatly needed benefits of the only sound practice—the alliance of physical remedies with drug remedies—work a great evil. It is to be hoped that time will right it.

In previous chapters we presented a closely condensed review of functional life phenomena and the relation of electricity to them, as determined by standard authorities.



SOME RECENT MODELS

PLATE V.—This group is shown here to still further illustrate with others that follow, the artistic designs and beautiful construction in very recent models in High Frequency apparatus for medical uses. They embody the best ideas of electrical engineering applied in behalf of the needs of the medical profession. A detailed description of their mechanism is unnecessary in this place.

No such massing of this important knowledge has been hitherto attempted by any writer on electro-therapy, and we are fixed in our belief that these chapters will prove helpful to an appreciation of electric currents in medicine and go far towards removing the popular ignorance concerning them.

The author of this volume hopes that many of the physicians who tell their patients that "no one knows anything about electricity" will peruse the preceding pages and *revise their viewpoint*. And to place before those who would accept enlightenment if light came their way we now present a very informing and suggestive study from the pen of Professor Jacques Loeb, long the head of the Hull Physiological Laboratory of the University of Chicago, and now the distinguished Chief of the Rudolph Spreckels Physiological Laboratory of the University of California and Professor of Physiology in that great institution. It should somewhat astonish doctors who repeat like parrots, one echoing the other, "*No one knows anything about electricity.*"

(Feb. 1, 1902.) "Five years ago I published a series of papers on the physiological effects of the electric current which impressed upon me the long-known fact that the galvanic current¹ is the *most universal and effective stimulus for life phenomena*. This fact suggested to me the idea that it should be possible to influence life phenomena just as universally and effectively by the electrically charged molecules (the ions) as we can influence them by the electric current. From that time on the whole working force of my laboratory was devoted to the investigation of the physiological effects of ions.

"My first aim was to find out whether or not it is possible to alter the physiological properties of tissues by artificially changing the proportions of ions contained in these tissues. . . . The next step taken consisted in proving that it was indeed *the electrical character of the ion that*

¹ It will be noted that this date was three years before high frequency currents began to come into use.

determined its specific efficiency. I succeeded in doing this three years ago.

"In the meantime I had become familiar with the brilliant experiments of Hardy (proceedings of the Royal Society, 1900) upon the influence of ions and the galvanic current upon colloidal solutions.¹

"My experiments showed that spontaneous, rhythmical contractions of muscles are possible only in solutions of *electrolytes*, and that the antitoxic effects of salts (in the experiments described) may be a function of the magnitude and the sign of the electrical charges of the *ions*.

"We have now to answer the question, How can the electrical charges of *ions* produce a toxic or antitoxic effect? The answer must be preceded by the answer to the more general question, How can the electrical charges of *ions* as well as of an electric current influence life phenomena? The basis for the answer to this question will undoubtedly be found in the work of Hardy (as well as that of Bredig) on the rôle of the electrical charges of the particles in a colloidal solution.

"Hardy has shown that living protoplasm is to be considered as a *colloidal* solution. Such solutions are suspensions of solid particles in water, the particles being from 1,000 to 10,000 times as large as the dimensions which the kinetic theory of gases assumes for molecules. *The forces which keep these particles in solution are of an electrical nature.* According to Helmholtz and Quincke there exists a double electrical layer at the limit between particle and surrounding water.

"When the colloidal particles have a positive charge the surrounding particles of water have an equal negative charge. It agrees with this assumption that the colloidal particles move under the influence of an electric current in the same way as *ions*. They move to the positive anode when they carry a negative charge, and to the negative cathode when they carry a positive charge. Hardy has made it probable that these charges keep the particles in

¹"Colloid means glutinous. The substances of the body which are not crystal-oid are of this gelatinous character. The substance of nerves is an important example. The bulk of our protoplasm consists of colloid material and the physical manifestations of life are due to changes of the condition of these colloidal solutions."

solution, as by reason of their charges they must repel each other.

"If their charges are taken away from the colloidal particles (through the oppositely charged electrode of a battery or through oppositely charged *ions*) they will be no longer held in suspension, but will either fall down or rise to the surface. The bulk of our protoplasm consists of colloid material, and the physical manifestations of life, such as muscular contractions and protoplasmic motions, and the innervations, are due to changes of the conditions of these colloidal solutions.

"We now may be able to understand why the electrical current *is the universal form of stimulation*. The reason may be that *the particles in colloidal solutions are electrically charged*, and that *every alteration of the charge of the particles will result in a process of innervation, or a contraction, or protoplasmic motion*, etc.

"The idea that the phenomena of innervation as well as those occurring in the central nervous system are due to changes in the colloidal solutions of the nerves and ganglions has been held by me for several years and found its expression not only in my lectures but also in the English edition of my book on the 'Comparative Physiology of the Brain and Comparative Psychology,' which appeared in 1900.

"Thus, on page 14, we find: 'It becomes evident that the unravelling of the mechanism of associative memory is the great discovery to be made in the field of brain-study, but this cannot be done by histological methods, or by operations on the brain, or by measuring reaction times. For we have to remember *that all life phenomena are ultimately due to motions or changes occurring in colloidal substances*.'

"The *thermo-dynamical* theory of life phenomena has utterly failed to show how the thermal energy produced through splitting up and oxidizing food stuffs can lead to muscular contraction. The facts point distinctly towards the possibility that part of the chemical energy in our body is transformed into electrical energy, or, in other terms, the *ions* formed in metabolism play a rôle in the dynamics of life phenomena.

"This view is in harmony with a view expressed by d'Arsonval who was the first one to claim that the muscle is

not a thermal motor. He assumes that changes in surface tension produce protoplasmic motions, and shows how electrical changes must lead to changes in surface tension, and this view accords with Hardy's and my own.

"It remains to be explained how the electrical energy of the *ions* may be transformed into the mechanical energy produced by the contracting muscle but I believe that the electrical energy of the *ions* is transformed into surface energy. It will now become necessary to pay more attention to the production of *ions* in metabolism than has been done before. The CO_2 and PO_4 *ions*, as well as the H *ions* can no longer be considered as mere waste products of metabolism.

"The fact that *ions* may act *toxically* through their electrical charges, and that *ions* with the opposite charge may act *antitoxically*, may open a new and very fertile field for pathology and therapeutics. As I have stated in previous papers certain neuroses and perhaps certain mental diseases may now find their explanation."

Look at the foregoing array of definite and demonstrated knowledge concerning the medical actions of high frequency currents, open to all physicians who will consult medical libraries. Digest the facts, comprehend their significance, and realize the patient toil of investigators, for these facts gathered into our brief chapters are the product of upwards of two hundred thousand separate tests extending through fifteen years of painstaking research—some of them covering the studies of a century.

Yet the ordinary medical journal article by such physicians as write on the subject of electro-therapeutics (even men engaged in teaching it in medical colleges and who should be better informed) is almost certain to say that no one knows how electric currents act upon tissues or how they produce their benefits in the treatment of disease. More than half the writers are apologetic for venturing to report good results they have obtained with this remedy, and expose their lack of reading by expressing "the hope that discussion will *some day* induce *some one* to investigate elec-

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trical actions so that 'we' may eventually learn something of their nature," etc. In view of such facts as this single book presents the professional attitude toward electricity is preposterous in the extreme.

We will next take up selected reports of practical experience with high frequency currents.

CHAPTER VIII

THE TESTIMONY OF EXPERIENCE WITH HIGH FREQUENCY CURRENTS

Some Misconceptions Removed. Results of Treatment by Physicians in Europe and America. Condensed Extracts from many Medical Reports. Clinical Results of 1900-4. Reports from General Practitioners and Dermatologists. Oudin, Doumer, and Apostoli. Results of the Specialist, the Surgeon, and Chiefs of Clinics. Results in Sanitarium Practice. The Convincing Verdict of Ten Years.

To those intending to employ high frequency currents in their own practice no information is more necessary and more valuable than to know what others are doing with the same methods. For this reason, and to avoid the possible charge of unsupported "enthusiasm" against the present author we shall now take the reader through a number of condensed extracts gathered from the reports of other physicians and confirming the results we have obtained in our own practice.

It has been necessary to cut these extracts to the utmost brevity, taking from each report merely enough to indicate the wide scope of work done and to make doubt of our own teachings impossible. These collated testimonies teach much and are of surpassing interest, for they reassure and *convince* the reader as no single authority could expect to do. In a multitude of witnesses there is strength.

But as some will here approach this subject for the first time it is wise to clear the mind of misconceptions concerning the dignity and place of electricity in medicine. We shall do it in a few words and then proceed with our proofs.

We accordingly affirm that no medical writer who has won recognition as a competent authority in the field of

electro-therapeutics has ever *over*-stated the value of electric currents in medicine.

Laymen, newspaper editors, and non-expert physicians, imagine that "exaggerated claims" and "enthusiastic writers" make up the literature on this subject, and all men know that "quacks" are devoid of truth. But these beliefs show non-acquaintance with the facts. Experienced medical men in this branch of practice seek ultra-conservatism, and shun exaggeration as science itself shuns quackery. It is hateful to the scientific mind.

Experienced authorities mainly report work done, tests made, results actually recorded. "Claims" are seldom indulged in. They are not marketable. They cure no patients. But the evidence of the physician in good standing who has personally treated 100 cases with a given remedy—an electric current—and who honestly reports his results for the benefit of his fellows, cannot be waived aside by the critic who has never treated a case and who *don't know how*.

The present author in his six previous text-books, correspondence instruction and clinical classes for physicians, has aimed to state nothing that was not demonstrably true, for he prizes beyond words the confidence of his colleagues. And the fact is that no text-book or contribution to a medical journal can be found in print, written by a reputable physician, which does not *understate* the case: while the fictions of "quacks" do not wholly lie in their general claims of the virtues of electricity, but are largely in their attributing to mere toy devices the efficiency of costly scientific apparatus, and in the mistakes which they make through ignorance. Moreover, there are really very few so-called quacks using electric currents on patients. There must be a hundred quacks selling drugs to dupes for every one who takes the trouble to learn enough about electricity to employ a battery.¹ Commercial makers and sellers of electric belts,

¹ The quack business in drugs in the United States is estimated at over \$100,000,000 per year, and enlists an invested capital of fully \$10,000,000 in manufacturing, advertising, and selling. It is probable

electric insoles for shoes, electric hair brushes, etc., of whom also there are very few, belong to another class; and if anybody is victimized by flashy advertisements it is his own fault. The medical profession is not responsible for that kind of electricity.

But the real therapeutic work of the most skilled experts in medical practice is so little known to other people that it is common to associate an imaginary idea of "exaggeration" with the whole subject of electric currents in medicine. Those who make this mistake should look up the facts—and they will find some of them in this book. Still more of them may be found in our standard books covering galvanic, faradic, and static-machine currents.

The too popular "family battery" purchased for a few dollars to "try electricity" is responsible for much of this unfortunate error. It is a worthless toy when new, soon gets out of order, and disgusts the deluded buyer, who thereupon blames *electricity* instead of the inferior apparatus he purchased. All such batteries are delusions. Whether one costs \$10.00 or \$20.00 it would be dear at as many cents. They are not constructed to produce medical dosage or supply the means of medical technique. Not even a master-expert could take one of them and set up medical actions in the tissues to meet diagnostic indications. Twenty years ago the author did not know this and he bought one, but he grew in knowledge with experience and consigned it to the scrap-heap. Although supposedly innocent of harm, they are the worst enemy the cause of medical electricity has ever known—far worse than bigotry, prejudice, or ignorance—and they deceive the public and retard progress.

Sad to say, even some honest but untaught physicians use these "buzzing" offenders against therapeutics—because that the annual quack business done with high-class electro-therapeutic apparatus, such as skilled physicians use, does not exceed the small sum of \$25,000, a quite insignificant amount compared with the enormous patronage of drug quackery. For either physicians or patients to raise objection against competent electrical treatment on this ground is ridiculous.

they are apparently cheap and the doctor is poor. Their use is the only example of broadcast quackery in the name of electricity extant. As well prescribe dried beans in a case of malaria as to "try" a tawdry faradic battery when in need of genuine electrical treatment. A competent faradic apparatus costs from \$50 upwards.

Now as regards high frequency currents: Among physicians using them in the treatment of patients there is very little difference of opinion as to their value, and if all physicians employed equally efficient apparatus and equal skill there would be no difference at all. But a score of manufacturers make high frequency apparatus and the varieties sold include both cheap and dear, good and medium, and others not so good as they ought to be. This causes variability in results and disagreement in opinions.

Nevertheless, if we find numerous physicians in widely separated localities reporting cases benefited by this remedy, and if we still find them confirming its value year after year since it began in 1900 to be increasingly used, we may convince ourselves that it is not a flash-in-the-pan remedy, to be exploited for a day and then forgotten.

Ten years of continuous experience and corroborating testimony is sufficient to establish the high frequency current as a therapeutic agent of definite and great value in the treatment of some stage or condition in the course of many acute and chronic diseases, and in many departures from physical comfort and energy which are not called disease, but which electricity will correct.

The extracts we shall now present are taken from leading medical journals, and many of them were part of extensive papers read before medical societies. In order to afford a proper judgment of the tests of time we shall begin with reports published in 1901 and bring the testimony down to the present date. A careful review of results collected in this way will either convict the remedy of merit or expose it to our gaze as an impostor.

These contributions may begin with the following taken

from an excellent summary on high frequency currents written in 1901 by the English author of a book on Practical Radiography and a physician of extensive experience in the uses of physical agents in his practice :

“ The application to therapeutic purposes of currents of high frequency is chiefly due to the work of such eminent men as d'Arsonval, Oudin, Doumer, and the late Apostoli, and the results obtained are—even in the short time which has elapsed since their introduction—of such importance and promise that it is safe to predict a great future for this new treatment.

“ We are often asked what ailments high frequency currents will benefit. While it is equally certain that from the directness of their action upon the cells of the organism an ever-widening field will present itself for their use as soon as their application has become general, it has been proved that they are efficacious in superficial ulcers, syphilides, psoriasis, eczema, acne, migraine, hysteria, sciatica, lumbago, rheumatism, rheumatoid arthritis, neuralgias, neurasthenias, insomnia, affections of the mucus membranes, dyspepsia, constipation, hemorrhoids, early tuberculosis, anæmia, chlorosis, chorea, pruritus, vaginitis, etc.”

From a medical journal article of the same year contributed by a leading New York dermatologist of veteran experience, who has since distinguished himself by brilliant work in this line, we take, briefly :

“ High frequency currents have for some time been successfully employed in the treatment of certain cutaneous affections, more in Europe than America, and I am enabled by personal experience to corroborate in great measure the reports that have been made in their behalf.”

“ Selected electrodes and regulation of the primary current make this discharge either a spray or a small and gentle spark of very short length. If the dosage is right the spark is soft on impact and painless, and unlike the direct Static spark from the Holtz machine. If fifty or a hundred of these rippling and non-muscle-contracting sparks are let fall on a single point of the skin it becomes slightly

reddened, and the blush remains for several hours, or even for a day or two.

"On close contact with either or both terminals we feel no sensory effects, but by the interposition of a dry resistance (as, one or more layers of clothing) over the tissues, the discharge is made irritant to any degree desired. I have used this current so far only with the local electrodes, the point and the metallic-lined glass tube. My use has been chiefly in connection with chronic infiltrated eczema, rosacea, acne, localized pruritus, pityriasis capitis, the localized eczema seborrhoicum and seborrhœa oleosum, in all of which resolution of the lesions was accomplished more rapidly than by any means previously at my command."

M. Paul Renaud, in Paris, at this date wrote an account of high frequency currents from their germ of origin in 1855 to their practical start in 1889 and their development since. It was devoted chiefly to descriptions of apparatus, methods, and characteristics of the various discharges, but mentioned that: "The improved bi-polar resonators are of great interest, as they create a zone of greater density of current between the two poles when it is desired to make a local application. Dr. Oudin reports four cases treated with the recent form, two of them being very rebellious cases of chronic pruritus, and two cases of pulmonary tuberculosis."

Dr. Oudin's report to the International Congress, Section of Electro-therapeutics and X-Rays, in Paris, has been summarized briefly as follows:

"The effects of high frequency currents can be divided into the following actions:

- "1. On motor and sensory nerves.
- "2. On the circulation.
- "3. On oxidation generally.
- "4. On micro-organisms.

"The effect on motor and sensory nerves varies according to the technique and amplitude of the oscillations of current. D'Arsonval in some of his experiments has used a frequency so high that neither motor nor sensory nerves

were excited, but with lower frequencies and by interrupting the current, the nerves will be excited the same as with other interrupted currents.

"The action upon the circulation has been observed by many authors. A lowering of blood pressure at the time of the application, and also an intense vascularization of the skin are observed. These currents can therefore cause a most active draining of the circulation.

"The action of high frequency currents on oxidation in the body is an effect fully established by the work of D'Arsonval. An increase in respiratory changes and in the quantity of the excreta is observed. The above facts have been confirmed by a great number of writers.

"We owe to D'Arsonval and Charrin most of our present knowledge of the action of high frequency currents on microbes and toxins. If the increase of temperature be eliminated they have but a weak action on the vitality of micro-organisms, but some of them can be attenuated and probably further research by improved methods will disclose more."

Dr. Doumer supplemented Oudin's report as follows:

"The therapeutic effects of high frequency currents of high voltage are much more distinct and precise than their physiological effects in a state of health. In diabetes, gout, rheumatoid arthritis, Bright's disease, etc., their effects are no more efficacious than those of Static electricity by Monell's methods. As early as 1893 Static electricity was applied to local affections of the skin, either as a spray or sparks, and cured certain skin diseases, both moist and dry, with surprising rapidity.¹

"This treatment of skin diseases by Static electricity has become a classic method, and it is observed not only that the area treated improves, but a deep and general result follows which extends to the whole organism. The high frequency currents seem to be more efficacious than Static currents, as we have applied them.

"As early as 1897 we applied high frequency currents to the treatment of anal fissure, with results so good that a

¹ "Static Electricity in Cutaneous Affections," by S. H. Monell, M.D., *Medical Record*, November 18, 1893.

cure was the rule, and benefit was often obtained on the first application. The congestive phenomena in the pelvis which so often accompany fissure are removed by high frequency currents. As the author announced in a former paper, hemorrhoids are, in the majority of cases, susceptible of cure by this current.

"These currents are not less useful in the female. They quiet local pain, cause the absorption of the products of former inflammation, and if they do not immediately cure metritis they at least relieve it even when it is gonorrhœal. In a word, all localized inflammatory states, justify this form of application.

"Their curative action on pulmonary tuberculosis is one of the most recent demonstrations of these currents. We have arrived at the conclusion that by the application of high frequency currents the general condition is improved, the bacilli diminish, the anorexia and fever decrease, and the pulmonary lesions cicatrize, even to a complete cure in many early cases. The results obtained are constant. Most of the therapeutical properties of these currents by their general methods of administration are due to the increase of tissue-resistance which they help to establish. Nature does the rest."

In a note on the action of high frequency currents upon elementary respiration and the activity of exchanges between the blood and the tissues, M. Tripet studied the effects in reducing oxyhæmoglobin. An abstract is as follows:

"MM. Apostoli and Berlioz have proved that under the influence of high frequency currents the production of urea is increased and brought near the normal amount, viz.: twenty-seven to thirty grams in twenty-four hours, in cases where defective nutrition showed itself by a marked hypoazoturia. *Their cases were watched for two years, before, during, and after treatment.*

"The examination of the blood were made with the hæmato-spectroscope of Henocq, the activity of the reduction of hæmoglobin being ascertained by his procedure of elastic ligature of the thumb, and the results were marked on special charts. The examinations were made every four

weeks from the beginning to the end of treatment. Some of the cases were thus followed more than six months. The results of treatment may be summed up as follows:

"1. In thirty-seven cases high frequency currents enhanced the reduction of oxyhæmoglobin, and this was especially apparent in cases of impaired nutrition—rheumatism, fibroid tumors, etc.

"2. In six cases the treatment reduced an existing hyperacidity to normal.

"3. In six cases the activity of the morbid processes was unchecked."

A résumé of the subject by a Boston physician concludes as follows:

"One of the most striking effects of the high frequency current is its action on the Sympathetic Nervous System. Applications of the vacuum electrode over the solar plexus will almost immediately relieve, and later, permanently cure, cases of long standing nervous dyspepsia, hepatic torpor, constipation, renal insufficiency, and, finally, all conditions due to lack of vasomotor stimulation.

"I have seen patients whose hands and feet had been cold and numb for months at a time, react immediately to treatment with the vacuum electrode over the epigastrium. The flesh and nails become pink, sensation returns, and the patient goes away feeling a glow all over the body.

"The immense glandular stimulation of these currents is seen from the fact that after holding a metallic electrode for a few moments the hand will be found bathed in perspiration. As a result of the vasomotor stimulation produced by these currents all local congestions are promptly alleviated, particularly congestive headaches."

Another physician, one of the ablest specialists in New York, stated the following as his experience with high frequency currents and the imperfect apparatus of eight years ago:

"I have succeeded in producing a healthy base in a very unhealthy ulcer by local treatment with a foil-lined glass electrode. I have also succeeded in curing one very obstinate

case of neuralgia which involved nearly every one of the intercostal spaces, and centered with great severity and persistence over the solar plexus. This case had resisted all other forms of treatment, both medical and electrical. The high frequency current was applied with the foil-lined glass electrode over the back, over the nerve-roots, over the entire chest, and especially centered over the solar plexus. It required only nine treatments at the rate of three a week to entirely relieve this patient.

"There has been an apparent success with this current in a disease in which I little expected it, and that was a very chronic case of arthritis deformans. The patient had suffered with more or less arthritic pains, accompanied by deposits in every joint, for the last fifteen or twenty years. He had finally reached a point where he was no longer able to work, and last of all his hands became about twice the size they were normally. Every joint, carpal and metacarpal, was involved. He was unable to close them sufficiently to hold anything in them, or even button his clothes. He was a dreadful specimen of this terrible disease.

"I began treating the hands simply with the high frequency current, using the glass electrode, and giving sparks from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length. The hands were showered with these sparks for fifteen or twenty minutes, three or four times a week. They were the last to be affected, and consequently, I reasoned, would be the first to show signs of improvement, and therefore I selected them for treatment. But they had been in a useless state for five months when treatment was begun.

"To my surprise they decreased in size so rapidly that I began to feel the deposits in them were no longer of the same character as in the rest of the body. The joints became more limber; he was able to button his clothing; finally able to close his hands.

"I then concentrated the treatment upon a knee joint which had been enlarged for more than two years, accompanied by some contraction of the hamstring muscles. I found also that this joint decreased and that the pain, soreness and stiffness decreased in proportion to the reduction of the size of the joint. It was noticeable that the action seemed to be local, results being obtained only on the parts that were treated.

"Doumer and others have treated numerous cases of fissure of the anus with uniform success, as follows: The electrode is introduced sufficiently deep to include the whole of the sphincter muscles. The violet discharge is then applied for from five to eight minutes. He claims that improvement is usually rapid. The pain gradually diminishes, the fissures become cicatrized, and spasms yield readily.

"He also claims that he has treated gonorrhœa very successfully. His method is to carry the current to the part by inserting an instrument into the canal, or a glass vacuum electrode on the perineum. Excitation at once diminishes, nocturnal troubles disappear, œdema decreases, and while sometimes the discharge keeps up yet he has seen a cure in ten or twelve days. He states that in epididymitis and prostatitis the results are marvellous. They yield to a single application, improve at the end of three or four minutes, and next day there is no pain at all.

"Oudin has reported numerous cases of eczema and psoriasis cured in a remarkably short time by high frequency discharges. It is generally admitted by all who have used this form of electric current that it has a great field in the treatment of hitherto incurable skin diseases. I might go on citing hundreds of cases cured by this remedy, for, while it is yet new in electro-therapeutics, its popularity is so great with all who have used it that hundreds of cases are already on record, but time will not permit."

A New York surgeon reported experience with high frequency currents applied only with the localizing vacuum electrode:

"The effect of treatment on the blood is shown in an increase in the number of red blood-corpuscles and in the percentage of hæmoglobin, together with a diminution in the number of white blood-corpuscles. As a rule in chronic cases where daily applications are given an ordinarily good result will be manifest in a month.

"This author reported 250 cases so treated by him, and concluded that the method was of value in both acute and chronic conditions. He had observed the benefit from its use in tuberculosis, syphilis, carcinoma, locomotor ataxia,

neuritis, torticollis, paresis, nerve exhaustion, impotence, diabetes mellitus, Bright's disease, septicæmia, oophoritis, dysmenorrhœa, anæmia and leukæmia.

"A considerable number of cases of pulmonary tuberculosis associated with fever and bacteriological evidence of mixed infection had been treated—advanced cases, treated only to observe the effects and not with any expectation of cure. In these cases two treatments were given daily, and in each instance the sputa had become more liquid, the night sweats had diminished, and food which had previously been rejected was retained. In a week or two there was an improvement in pulse and respiration, with free expectoration of shreds of tissue and a very large number of bacilli. The action on the bacilli was demonstrated by daily examinations.

"In external suppurative inflammation results were secured which in two or three instances were little short of marvelous. The benefit was especially noticeable in cases of mastoiditis where operative measures were apparently indicated.

"In ten cases of diabetes mellitus the results were gratifying. The quantity of sugar averaged in these cases from one and a half to four and a half per cent. Brilliant results had been obtained in both acute and chronic alcoholism. In cancer the general health had been markedly improved, with diminution of pain, odor, and discharge. Twenty-five cases of muscular rheumatism were treated with complete success in all. In rheumatoid arthritis the results were good but more slowly obtained."

The limitations of this small book stop us from multiplying further extracts from medical reports on high frequency currents during 1901. Those we have quoted are the experience of well known practitioners of high standing in the profession and whose clinical reports are accepted by all who read them.

As we proceed it will be of interest to note how far this remedy has sustained in continued experience the earlier impressions of its value. No "fake" remedy or spurious clinical reports can endure without exposure the searching tests of time, and if we find high frequency currents repeat-

ing in other hands and in successive years the favorable results reported in previous pages the testimony is conclusive. Allowing an interval to mature the impressions of investigators we pass over the reports of the next three years and will cite selections from the medical journals of 1904-5.

"A brilliant contribution on the subject has been made in the London Lancet by Dr. Alexander Crombie and Dr. T. J. Bokenham (surgeon), who showed that a cure could be effected by the high frequency current in atonic dilatation of the stomach. They gave full notes of seventeen patients treated by them. All were cases of non-obstructive dilatation of the stomach varying from a few months to several years' duration, attended with well-marked characteristics.

"In all these cases, after from ten to twenty applications, the stomach was found to have assumed its normal position. At the same time in all but two of the patients the normal process of digestion was restored. Those who know the unsatisfactory and uncertain results of the ordinary medical treatment of primary atonic dilatation of the stomach will agree that the results reported in fifteen of these cases would not have been possible with ordinary measures. After first carefully defining the limits of the dilated organ it was found in all cases that the application of the current was followed by a recession of the boundary from a half to three-quarters of an inch in all directions. This result was invariable. We know of no effect of any other remedial agent in the whole domain of practical medicine which is so certain and so conclusively demonstrable as this retrocession of a dilated stomach on the application of a high frequency current."

One of the same physicians, chief of a clinic in a large hospital, who has already been cited among our 1901 extracts, makes the following contribution in 1904 from a greatly increased experience:

"My series of clinical studies concerning the therapeutic possibilities of high frequency currents have been continued up to the present time. Over 500 cases have been treated,

covering a wide range of pathological conditions, both functional and organic. The results were almost invariably beneficial, and in many cases permanent cures were effected in patients who had proved refractory to other forms of treatment.

"Clinically, these currents produce a general vitalizing and invigorating effect without undue stimulation. Speaking broadly, we have in the high frequency currents the closest approach to artificial vital force that has yet been produced. Extreme as this statement may seem, it is fully borne out by clinical observations.

"Tissue combustion is increased in all parts of the body. The writer has made a large number of urinalyses in connection with patients under treatment and has found that these currents will oxydize uric acid into urea and increase elimination of waste products to a remarkable degree.

"Another universal effect of these currents is their strong tonic action on the vasomotor system, flushing the blood through the peripheral capillaries, opening the sweat glands, relieving local congestion, and causing a general sense of warmth and well-being throughout the body of the patient. The vacuum electrode and other methods in which glass is interposed between the patient and source of current have been widely employed, both in Europe and in this country. By their use notable local effects in the line of tissue regeneration and in the alleviation of pain can be produced at will.

"In addition to these effects we can produce wonderful results by the use of a brush or spray discharge along the spine, above the head, or over the solar plexus—the centers of the nervous system. Again, connecting the patient directly with two metallic electrodes, in series with a small air gap, we can cause powerful and painless muscular contractions, at the same time causing the general vitalizing and invigorating effects which are characteristic of high frequency currents.

"Many modifications of methods have been devised, enabling the physician to command the beneficial effects of faradic, interrupted galvanic, and sinusoidal or static currents, and in addition, to obtain the remarkably curative and lastingly vitalizing action which is peculiar to alternating currents of high frequency and very high potential. The apparatus also affords a convenient means of generating

pure ozone for treatment of pulmonary diseases. Skin diseases form another important field for high frequency currents."

Again:

"The effect of a high frequency current on the human body differs from that of any force with which we are familiar. It is no more like the effect of an ordinary electric current, galvanic, faradic, or static, than is the effect of the X-ray like light. It may be defined as an intense vitalizing force. The slight increase in stimulation, in vital action, produced by the vibration of a faradic coil cannot be compared with the intense oscillatory force which passes through the nerves and tissues when the high frequency current is applied to the body and which gives rise to increased vitality, increased chemical action, etc.

"This current is not a stimulant; it is a *vitalizer*. It does not act like a glass of wine, increasing the heart's action for a short time to be followed by a reaction, but it absolutely adds energy to the body—energy which is stored up in a potential form and may be used in all the processes of the body. This can be demonstrated in various ways.

"Cases that have been under treatment for various diseases in the past demonstrate that the effects are lasting. The most obvious way to demonstrate the wonderful increase in tissue combustion produced by the high frequency current is in cases of gout, where the urine is loaded with urates. Chemical analyses made before and after the use of high frequency currents show a marvellous difference, the urea increasing while the uric acid disappears. For this reason these currents are beneficial in any condition of the system where the vital forces are depleted.

"High frequency currents produce definite therapeutic results which are not due to 'suggestion,' and these results can be demonstrated over and over again. They cannot be entirely duplicated by any other remedy with which we are at present familiar. The anæsthetic effect of this current is susceptible of many applications, and I should imagine it would be a valuable addition to a dentist's office. It is possible to relieve the pain in acute neuralgia in almost every case by a short H-F treatment. This relief is not always

permanent, although many cases have been entirely cured by a number of applications.

"When a vacuum tube electrode is applied to the skin it becomes warm and can be made quite hot by intensity of dosage. An active chemical change takes place in the immediate vicinity of the electrode, and ozone is produced in the tissues in large quantities.

Again in 1904 we find another contributor, quoted previously in 1901, a well-known professor of dermatology, and consulting surgeon to one of the New York hospitals, sending a lengthy report to the Medical Record, from which we take only the clinical mentions, most of the article being occupied with discussions of apparatus and methods:

"High frequency currents can be produced in various ways, but the currents themselves differ materially in character and dosage-value and can hardly be expected to produce exactly the same effects.

"Physiological experiments by leading authorities have shown that the current induced by the large solenoid notably increases the respiratory exchanges, the excretion of the urinary solids (including urea, uric acid, and phosphoric acid), the toxicity of the urine, and the radiation of heat from the body. In other words, there is a decided increase in the general metabolism.

"When we consider the large number of affections now recognized as depending on or accompanied by defective or retarded catabolism, the physiological data above given will readily indicate the therapeutic measures that may with confidence be pursued. If we rely on drugs to eliminate 'materies morbi' or waste products from the system we have at command diuretics, cathartics, diaphoretics, alkalies, and substances belonging to the salicylic group, but none of these has in my hands yielded as satisfactory results as may be obtained from high-tension electricity, whether through the static machine or high frequency currents. I consider these therapeutic agencies of high importance."

A Southern physician of long experience and high standing as the head of a large sanitarium concludes an article on high frequency currents with a report of the following cases:

"Case 1. Miss M., age 38, a neurasthenic of a number of years' duration, was making a very satisfactory, though slow, improvement under the general application of massage, baths, rest, etc. She had been very anæmic and run down for several years, and had suffered two previous attacks of phlegmonous paronychia. For several days she complained of the classic symptoms of pus formation in the left thumb, and about the seventh day presented herself with a small abscess the size of a large pea. This was evacuated and dressed dry.

"The high frequency current was then applied for five minutes, using a vacuum electrode attached to the positive pole. The pain was relieved before the sitting finished, and, to my surprise, upon removing the dressing next day, pus had ceased and only a serous discharge was present. She made an uninterrupted recovery, healing in five days.

"Case 2. Miss L., a neurasthenic with marked gastric dilatation and gouty symptoms. While under treatment she had a commencing bone felon. Remembering the effect of high frequency in previous case, the current was applied for five minutes at a time for seven treatments, resulting in prevention of pus and complete recovery.

"Case 3. Mrs. H., marked dyspeptic of atonic type; intensely gouty. A large boil developed on her neck and was purulent before seen by me. It was lanced and evacuated and high frequency current applied for five minutes daily. Prompt restoration took place.

"Case 4. Mr. H., a student, neurasthenic, with marked depression and fears. Had been under treatment for two months, gaining well in weight, hæmoglobin and general nerve tone, but troubled with large acne pustules. The persistent and careful application of the high frequency current to these pustules not only checked their formation, but relieved the induration and improved the general condition of the skin.

"Case 5. Mr. Y., sciatica of arthritic character. Developed small ulcer on right leg. Applications of high frequency current established prompt granulation and steady healing.

"Case 6. Mr. K., recurring attack of eczema on left forearm, in case of gastric dilatation and hyper-acidity.

Applications of high frequency every second day for two weeks promptly relieved the eczema.

"Case 7. Mr. A. M., age 27, marked neurasthenic, and suffering from the severest vasomotor ataxia that it has ever been my lot to observe, called my attention to an intense itching in both legs over the tibia. There was no external evidence of any skin irritation or eruption, and I concluded that it was purely nervous in origin.

"The trouble was so intense and the itching so disagreeable that he insisted upon some local means of relief. A mentholated power and a lotion had no effect. But the first application of high frequency treatment checked the itching for six hours. Eight or ten applications made the relief permanent.

"Case 8. Miss S., age 36, neurasthenic, with gastric dilatation, fermentation, and hyper-acidity. During this condition she developed an itching of an exceedingly disagreeable character. High frequency treatment promptly gave her relief.

"Case 9. Miss E., one of the most marked lithæmic cases I have ever seen. Has been under my care at intervals for the past ten years for gastric, renal, and nervous disturbances arising from this condition. She developed a painful spot a little larger than a silver dollar to the right of the spine just below the shoulder blade. Static and galvanic currents which had heretofore given satisfactory results absolutely failed. Persistent applications of hot fomentations, douches, and general hydrotherapeutic measures also failed to affect the pain, though of general benefit.

"An application of high frequency current was then made, with the result that inside of two weeks relief was obtained which has lasted until the present month, when she again felt the pain, and further high frequency treatment gave immediate and positive relief.

"Case 10. Mrs. G., gouty, developed an acute inflammation of the right thumb; hot, swollen, throbbing, and painful. General treatment was given and also to the thumb a local application of high frequency was made. Its anæsthetic action was similar to cocaine upon a mucous membrane. Marked vascularization of a pink, healthy color, together with local perspiration, followed each H-F treatment,

and in two weeks relief of the local condition of the thumb was obtained.

"Case 11. Mr. F., lawyer, very nervous and anæmic, complicated with mitral lesion of the heart. General treatment restored him to health, but while in my hands he developed a small ulcer at the base of the gums which resisted every local application, including a thorough silver nitrate cauterization. While a little thing, it was exceedingly painful and annoying to one in his nervous condition and materially interfered with eating. The application of the high frequency current very promptly relieved the trouble."

We shall continue this interesting account in our next chapter, for if there is any virtue in the old saying that "the past at least is secure" it must be important for us to know what, and how secure, the past of high-frequency currents has been in the practice of their investigators. The instruction of experience is the basis of progress.

CHAPTER IX

ADDITIONAL TESTIMONY OF EXPERIENCE

Extracts from Important Reports Continued. A Chapter of Valuable Information to all who Employ High Frequency Currents. Constipation and Hemorrhoids. A General Practitioner's Results. Gastro-Intestinal Conditions. Acne and Eczema. Summary of 175 Skin Cases. Port Wine Mark. Cases in Office Practice. Albuminuria and Infected Gall-Bladder. Uric Acid Cases. Relief of Insomnia. An Episode.

THE following condensed extract is taken from an article on the treatment of constipation by high frequency currents, by a New York physician :

I have employed this treatment for the past two years with such excellent results that its general adoption seems desirable. My first application of the high frequency current to constipation was accidental. I was treating a case of chronic prostatitis through the rectum with the glass vacuum electrode, a method which, by the way, is efficient in a large percentage of cases, when the associated constipation from which the patient had been suffering was improved to such a degree as to attract attention.

Being aware of the reports of French physicians on high frequency results in constipation and hemorrhoidal conditions I resolved to test it on a severe chronic case and determine its possibilities myself. The case was one of thirty years' standing, with constant drugging during that period. He presented a perfect picture of atonic constipation complicated with piles and mal-nutrition. First advising as to general diet and hygiene he was placed on the operating table face downward and a small vacuum electrode, well lubricated, inserted into the rectum.

In this case ten treatments were required before a natural passage was secured, the patient meanwhile using ene-

mas to assist. No medicine of any kind was used as I desired to test the current alone.

If spasm or pain exist the pain and contraction usually abates quickly and after several treatments they remain absent. Fissures also heal. Hemorrhoids in many cases reduce in size and in several cases have absolutely disappeared, so that I now use this method for hemorrhoids also.

In several cases where the portal circulation was at fault, persistent treatment over the liver for fifteen minutes helped the improvement."

I have since used this method in a large number of cases during the past two years and have yet to meet my first failure."

A Western physician contributed some of his experience with high frequency currents to a medical journal, from which we take a part of the clinical cases:

"I am strongly inclined to conservatism in the use of new remedies and let others do the experimenting, but when the merit of a method is proven beyond the possibility of a doubt I am ready to adopt it for my patients.

Having read that the high frequency current was capable of relieving the pain and swelling of ordinary sprains (and having purchased an apparatus) I was applying it for the relief of that painful condition in the wrist of the wife of one of the prominent business men of this city. The husband watched the treatment and was highly gratified with the rapid relief, and remarked, "I wonder if that would do my face any good?"

He had a lupus of the face, fifteen years' standing, involving nose, lips, chin and cheeks, making a complete circle from just below the eyes. He had had much treatment with no benefit, including treatment by a New York specialist. The open ulcerating surface would aggregate a total equal to the area of three silver dollars.

He came to my office for high frequency treatment seven times, when the entire surface was healed over.

Another case, equally satisfactory, was G. M., age 47. About two years ago he observed a small ulcer on the lower lid of the left eye. Ordinary medical treatment failed to heal it. He then went to a prominent dermatologist who

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pronounced it epithelioma and treated it without avail. A second specialist also treated it without success. Then he came to me. I found a typical case of epithelioma, involving the inner half of the lower lid. In seven treatments all ulceration, swelling, etc., had disappeared, only the scar remaining.

Mrs. C., was a case of aggravated rectal ulcer, three large ulcers being easily discoverable. They healed with five high frequency treatments.

Mrs. B., had suffered for many years with a chronic ovaritis and had been strongly urged to submit to operation. She had acute aggravations several times a year. The right ovary was the size of an orange and exceedingly tender. The left was not quite so large. She had profuse leucorrhœa. The uterus was bound down by adhesions and was boggy and tender. She was a confirmed invalid. I treated her with high frequency current daily for fifteen days, when she returned home feeling entirely well symptomatically.

In this year of 1904 one of the two chief specialists of London, England, in the use of physiologic remedies wrote an article on the treatment of some affections of the digestive organs—a careful résumé of apparatus and methods—but with a clinical section from which we extract the following:

“There is no exaggeration in saying that these currents put an entirely new power in our hands in treating this class of diseases, and enable us to effect cures in cases where other measures have proved useless. The key to the understanding of the effects of currents of high frequency is to remember that they can be made to exercise a manifold action; viz., to increase metabolism, to allay sensibility and pain, to stir up the sympathetic system of nerves and increase or diminish the functions of glands, to tone up unstriated muscular fibre, and incidentally to act as a general tonic.

“As regards my personal experience with high frequency currents, in the various forms of gastro-intestinal catarrh, I have found them of use only in muco-membranous colitis. In several cases of this nature its use promptly relieved the paroxysms of pain, and in the course of several weeks the

patient's condition was materially improved. I have not yet used it in chronic mucous gastritis.

"These currents also do good work for me in constipation of either atonic or spastic origin. I have notes of several very successful cases which I have treated.

"In my experience good results are also obtained in the slighter degrees of gastric atony which so often accompany general neurasthenia. Severer cases need other methods with another current.

"In the painful gastro-intestinal neuroses I am partly waiting for a new electrode, but have had an opportunity to test high frequency in two cases of intestinal cramp and colic with complete success. One of them had been operated on for appendicitis by a surgeon who wrote me that it was one of the worst cases of septic peritonitis he had ever seen. Since the operation the patient had suffered from attacks of abdominal colic of a very severe nature, much resembling gallstone colic. At the wish of the patient, without much expectation of doing him good, I commenced the daily application of high frequency currents. The attacks ceased from the first and he remained free during a course of six weeks treatment, when he came with acute pain which had lasted an hour on his arrival. It disappeared under the high frequency application and he took three weeks further treatment. His relief has continued for the past ten months."

"The second case was a gentleman, aged 48, who had for several years suffered from weekly attacks of a severe nature. The attack would commence about the middle of the afternoon with nausea. In a short time colicky pain in the lower abdomen would supervene, which reached its highest point of intensity about midnight. It then gradually declined until about breakfast time it had entirely disappeared.

"During the height of the pain vomiting would frequently take place but without relief to the pain. There were no signs of tabes, the gastric secretions and motility were normal and there had never been any jaundice. Although carefully examined on the sieve no gallstones had ever been detected in the evacuations. Diet had no effect, and normal digestions and stools excluded intestinal irritation as a cause.

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"Treatment was commenced with the high frequency current daily. At the end of the first week there was an attack but of less severity. He was treated six weeks. For the past year there has been no return of the pain."

In a general review of high frequency currents in medicine a Chicago physician of some prominence wrote of his own results as per the following condensed extract:

"The most notable results with this treatment have been obtained in the very common disease—eczema. While other treatments have been mainly palliative and many cases recur as usual even after high frequency, yet with this current we can sometimes actually cure these conditions with a few short treatments. Many cases of eczema of a dozen years' standing have been cured in ten treatments or so. The most sensitive parts can be treated without aggravation. Acne in all its forms yields readily to this treatment. Psoriasis is also amenable to it. We have personally treated three physicians having this disease.

"In the majority of primary cases epitheliomas react favorably to this current. Indolent and fissured ulcers respond rapidly to this treatment and clinical tests reveal results which must be considered as permanent. It supplants the x-ray and Finsen methods in many cases of lupus and has given better results. Many operators now prefer it.

"High frequency currents also prove of value in catarrhal conditions of mucous membranes, and for neuralgias. Even for sciatica, tic douloureux, choreic and hysterical spasms, they offer a very effectual measure of relief.

"Among the many general diseases favorably affected by them are neurasthenia, rheumatism, gout, tuberculosis and obesity. In diabetes so many have obtained such good results that it seems as if we now had a remedy to cope with this disease. Decided results are obtained in treating anæmia and chlorosis.

"Although from the list of diseases cited you may form an idea as to the wide action of this new therapeutic agent, it may be further stated that it *brings results*, if properly applied, in the majority of cases. If time were not limited at this meeting I could report an extensive list of cases, and

if verification were necessary, I could, in many instances, even produce the patients."

Another Chicago physician in the same year also made an extensive report before a medical society, with numerous cases and description of methods, in which he says:

"I have selected these cases to demonstrate the advisability of brief doses at frequent intervals, preferably sittings of five minutes. There is no question concerning the accumulative benefit of this form of high frequency treatment when properly conducted, not forgetting that local lesions are, in almost all cases, much benefited by general treatment. I believe it to be splendid practice to give, after each local high frequency treatment, a general treatment to the spine, body, and limbs. I have used it in deafness, atrophy of the optic nerve, trifacial neuralgia, neuritis, paralysis, locomotor ataxia, rheumatism, rheumatoid arthritis, diseases of the rectum and prostate gland, with marked benefit in all cases."

In 1904 Dr. Charles Warrenne Allen, the dermatologist,¹ contributed the following (in much greater extenso) to the Medical Record:

"It must be conceded that we are passing into the dawn of a day of physical methods in medicine. Not only does the physician of 1904 give fewer and less drugs than his brother of 1894, but the patient is, I believe, less inclined than formerly to take large and frequent doses of physic.

"As a dermatologist I have found myself drawn into the employment of a variety of physical methods during the past few years, several of which have to do largely with electric currents. We have, beyond a doubt, in these currents a method of stimulating vital energy hitherto unknown. A physiological and chemical tissue-change has been shown experimentally which puts the matter beyond question. Locally as well as generally, nutrition is improved. Electricity is a tonic to the skin in lowered condi-

¹ Professor of Diseases of the Skin, Post-Graduate Medical School and Hospital, New York City.

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tions of this organ, just as it is a tonic to the system at large when given in a way to affect the whole organism.

"During the past three years I have employed high frequency currents in my office practice in a somewhat wide range of skin diseases. In dermatology, so far as I can judge, the chief benefit of these currents is in cases marked by itching, pain of neuralgic character, and in the various parasthesias.

"In chronic eczema I have found the local application of decided value in alleviating symptoms and in diminishing infiltration. In lichen planus not only are the lesions improved at times, but the element of itching is relieved and general benefit is secured. In zoster of the thigh and arm with hyperæsthesia and neuralgic pain, not only has temporary relief been afforded immediately after each treatment, but the whole course of the disease has been shortened and the lesions have healed more promptly than without their use.

"In looking over my case books I find 175 cases in which the use of high frequency currents has been recorded, but these form only a part of all patients so treated, as scarcely a day has passed that I have not made use of this agent since November, 1901. The recorded cases include 37 of acne, 26 of alopecia, 27 of eczema, 8 of pruritus ani, 8 of pruritus vulvæ, 2 of general pruritus, 5 of pityriasis rosea, 3 of urticaria, 4 of lichen planus, 1 of mycosis fungoides, 3 of zoster, 3 of rosacea, 2 of pruritus hiemalis, 1 of pruritus scroti, and scattering cases of psoriasis, chloasma, ichthyosis, keratosis pilaris et follicularis, warty growths, moles, erythema nodosum, generalized molluscum contagiosum, scabies, dermatitis, dermatalgia, ulcers, etc.

"The vasomotor effects may be well studied in urticaria. Here sparking the wheal produced entire disappearance of the lesion, which is replaced in a few moments by a blanched area. Vascular redness soon returns, the area of this being larger than the lost wheal. The effect of contraction followed by dilatation is very marked. The spray application soothes the itching. Internal measures are not to be neglected.

"High frequency currents aid in relieving symptoms in a large class of cases, are of decided advantage, but in themselves possess only restricted curative properties and

are especially to be employed in connection with other measures."

In "American Medicine" early in 1905 we find that veteran skin specialist, Dr. L. Duncan Bulkley, reporting "Another Year's Experience with the Finsen Light, Roentgen Rays, and High Frequency Currents in Certain Diseases of the Skin." He premises: "One year ago I had the pleasure of presenting to this Society, somewhat enthusiastically, my personal knowledge and experience in regards to the matters referred to in the title of this paper, and the incoming president very wisely asked that the same be again presented after a year's further experience. This is gladly done, for it is always well in medicine and surgery to have previous experience confirmed or refuted." The high frequency portion of his report is summarized as follows:

"During the past year I have treated twenty-seven private patients, with nine different cutaneous conditions, by means of high frequency methods, using only local electrodes, and it has proved a very valuable treatment in many instances.

"As reported last year, I have found it very serviceable in the removal of warts, which are often very troublesome, especially when on the scalp. Ten patients have been thus treated with excellent results. A single thorough application produces a moderate inflammation, often with slight hemorrhage in the tissues, and the wart dries down, falls off, and the process ends without a scar.

"The same treatment has also been used with good result in four cases of small pigmentary moles on the face, these requiring several applications, destroying one layer of tissue at a time so as not to act too deeply and leave a scar.

"Last year I reported an extensive port wine mark on a girl's face, the parts of which that were treated became almost normal. This year I had a more striking case. Miss W., age 24, right side face, neck and ear, disfigured by brilliant purple port wine mark. Various treatments for years had not diminished the area. The application of

high frequency (hyperstatic transformer, carbon electrode held at one inch) has been most gratifying. Considerable areas have returned to almost normal color leaving only congested redness and in striking contrast to the areas so far untreated. There is a slight superficial destruction of tissue involving some of the blood vessels following treatment, and in five to seven days the crust falls and the tissues beneath show a pale pink which gradually whitens.

"If this form of electricity should accomplish only the satisfactory removal of these disfigurements, which render so many lives unhappy, it would be a boon worth having.

"I have used high frequency on three cases of acne this year, in connection with other proper treatment, and the result has been satisfactory. Three patients with lupus erythematosus have been under treatment and while not yet cured some patches have disappeared leaving very little disfigurement.

"Two patients with eczema have been thus treated with favorable results. The current aids in removing the thickened patches and in controlling the itching. Taking the year's retrospect of this method of treatment I am impressed with the fact that we have in it a method which promises greater utility as we learn more of its powers."

"Redard and Barret report the successful treatment of keloid by the high frequency current. A seven-year old girl with an extensive, thickened keloid on the arm was given forty applications. At the end of treatment the lesion had entirely disappeared and the skin had again resumed its normal condition. Two small keloids in the neighborhood of the large one were also cured. At the end of the year there had been no relapse."

The practical value of this agent to any physician who will use it is well illustrated in a long article by a Michigan physician contributed to a Western medical journal. We condense a part of it:

"My personal interest in this subject was aroused by reports from Continental sources of the marvellous physical

and physiological properties of the high frequency currents. . . .

"The cases cited were all treated in my general daily practice. One of my first cases was a business man who had arisen that morning with a very stiff back, but managed to get down town. During the morning it rapidly developed into acute lumbago with intense pain, so that he was with difficulty helped to my office.

"I applied the high frequency current with vacuum electrode for fifteen minutes to the bare skin of the back, at the end of which time the patient emphatically asserted that he was entirely well and had no pain whatever. He could take any position he wished. He refused to go home and took no medicine. He returned at once to work and had no recurrence after that single treatment. I have verified these results with many acute lumbagos since, except that often the pain returns somewhat after thirty-six hours and the patient requires an additional treatment or two. A similar case was a young man with acute torticollis. The effect of treatment was immediate, patient left office wholly relieved and there was no recurrence. No second treatment.

"Another case was chronic rheumatism of the knee, which had caused limping and much suffering for a year. It will illustrate the extraordinary analgesic powers of the current. The first treatment of fifteen minutes wholly relieved the pain and the patient walked off without a limp. Symptoms returned in thirty-six hours. After fifteen treatments applied every second day the knee remained well.

"Gout is a fine subject for high frequency treatment: Pain is at once relieved and the swelling and redness disappear after a few treatments.

"The high frequency current is of marked service in many rectal disorders. In one case, a chronic fissure in ano with ulceration, the lesion healed with surprising rapidity. Pruritus ani, one of the most distressing forms of itching that afflicts mankind, is largely controllable by this means. Hemorrhoids which can be replaced seem to be curable.

"The most remarkable case I have to report is that of a woman of 66 who for the previous four days had been in constant pain in the rectum and throughout the pelvis. For several months she had felt more or less pain daily, espe-

cially on defecation. Pain was now constant, day and night. Stools were like thin ribbons. Digital examination showed the rectum below the internal sphincter filled with a nodular growth nearly closing the passage. The speculum also showed the rectum blocked and the canal reduced to a mere slit. No ulceration and no discharge. I made a tentative diagnosis of cancer of the rectum.

"She begged for some relief and sleep, and morphine seemed inevitable. But first I put the analgesic power of high frequency electricity to a test. I inserted a vacuum electrode and applied the current for twenty minutes. She then sat up and told me in sober earnestness that all the distress and weight in the lower part of the abdomen had completely vanished.

"Except a restricted diet and oil enemas she had no other form of treatment. There was a slight return of symptoms next day and she had another treatment. I advised a surgical consultation and operative procedure if found necessary. Her son in Chicago saw Dr. Bevan and came to take her to him. The patient, however, refused to go and insisted on continuing high frequency treatment. Pending a final decision I treated her every second day, and she made a marked gain in general health. The pains never returned. Defecation became easier and finally normal, and by the time she had had thirty treatments no obstruction or growth in the rectum could be detected. She then consulted Dr. Bevan, who pronounced her free from rectal troubles. My suspicion of cancer was an error, but whatever it was, the result of high frequency treatment transcended anything in my experience.

"A lady of 50 with cystitis had suffered the usual tortures of that malady for four months. Her nights were especially miserable from incessant and painful urination. The alkaline urine contained 50 per cent of pus, a trace of albumin, but I could find no casts. Under urotropin improvement was made, but complete relief was a long way off. She also had hemorrhoids and rectal pain on defecation.

"After two high frequency applications she informed me that her bladder was being helped by the rectal treatment. To test this I inserted a slender electrode into the bladder itself and applied the current fifteen minutes. The next day

I received a telephone message from one of the most grateful patients I ever had. 'For the first time in months,' she said, 'I slept nearly all night and could urinate without pain.' Within thirty-six hours the symptoms began to return, but twenty treatments, together with urotropin, brought the case to a favorable termination."

"A case that I had operated on for dysmenorrhœa announced, after four months, that her pains were returning. Medication failed. At each period the pains began shortly before the flow and continued for three days. On test of high frequency it was found that a single application of ten minutes with electrode against the uterus relieved the attack for the given period, but did not prevent return next month. Nothing did.

"A fireman had a painful scar for which I advised excision, but a test of high frequency was made. Pain abated at the first treatment. My assistant gave daily treatments to the scar, which became very red, and under a lens fine capillaries could be seen ramifying the old scar tissue. After a week we stopped to let the inflammation subside. In another week redness disappeared and the prominent scar was nearly absorbed. It has remained free from pain. The high frequency spark was used.

"It is easy to remove warts, moles, and corns with the high frequency spark. One application is usually sufficient for small areas. It is of great efficiency in the cure of x-ray excrescences from the hands of operators, as I can testify in my own case.

"Such an efficient and practical therapeutic agent as this should be more fully appropriated by the medical profession."

A general practitioner reported in the Lancet-Clinic:

"In my experience the treatment of acne has been the most satisfactory of all cases. The general practitioner cannot do as much with the x-ray as the surgeon or skin specialist, but he will more than balance the account with the high frequency current from the same apparatus. In one case I have treated for albuminuria the urine was entirely clear after a few treatments over the kidneys with a glass vacuum electrode, and the eye symptoms, vertigo, and general malaise also disappeared.

"I am unable to say how permanent the results in this case will be, as only a few months have elapsed. In another case the result was not so good, as there is still a trace of albumin after several weeks' treatment, though in every other respect the patient is apparently well. This last was a very old case, and six years previously the segregator showed a large amount of albumin from each separate kidney.

"In insufficient action of the kidneys and where the specific gravity is low, the amount of urine will be increased and the specific gravity brought up to normal by a single treatment with high frequency."

"I have treated one case of infected gall-bladder with splendid success. I believe that all infections of the gall tract should be operated as soon as diagnosed, but in this case an extremely weak heart and unfavorable circumstances prevented my doing so. He was confined to the house. He had a horribly fetid breath, which was only made bearable by the free administration of acetozone. He was jaundiced, had an enlarged gall-bladder, with pain radiating to right shoulder blade.

"Under high frequency treatments all symptoms improved. The skin cleared, the foul breath was corrected, the swelling in region of gall-bladder went down, circulation improved, gastric symptoms disappeared, and he is now comfortable and goes about as he pleases. Aside from its tonic effect the high frequency current has a *drying effect on mucus*, and the general practitioner, as well as the gall-bladder surgeon, is beginning to learn that mucus, wherever found, is a culture medium for bacteria. In the above case I do not believe the beneficial effect to have been due to the destruction of germs or the solution of gall-stones, but to the stimulant action on the blood and nerve currents, the general invigoration of the systemic functions, the lessening of the production of mucus, and then the gradual reaction of nature under these more favorable conditions. I believe that in the suppression of mucus by the drying discharges of currents of high frequency and high potential a great stride is made in the treatment of disease, as the mucus is a culture medium for bacteria."

Among New York physicians there have been a few active investigators of the chief physical agencies employed in

medicine and from one of the numerous reports of their experience made by this group of men the following is taken in abstract:

"My 'Uric Acid Technic' in gouty and rheumatic conditions consists in the application of vibratory massage over the abdomen and up and down the spine for about ten minutes twice a week, and the application of high frequency currents on the same days, for about fifteen minutes, over the abdomen, up and down the spine, and over the affected joints and nerves.

"By the high frequency discharge through the glass vacuum electrode a certain amount of ozone is generated, some of which is carried into the tissues and which can be detected on the surface several hours later. In addition, a current of very high frequency and tension and of about one hundred and twenty-five milliamperes in volume passes through the body of the patient. This is a current of greater actual volume than can be comfortably administered in any other manner—i. e., by galvanic or faradic currents—and in this case there is no sensation at all except a gentle warmth.

"The ultimate beneficial result has been demonstrable in the urine as well as in the bodily condition of the patient. Probably what takes place is a counter-irritant effect upon the superficial nerves, with a reflex effect upon the blood circulation in, and functional activity of, the internal organs, and a certain added oxidizing effect from the free ozone absorbed, and an effect from the ultra-violet and other rays so abundantly present.

"One characteristic case is that of Mr. J. P., aged 54, diathesis inherited from mother, always soft, liver torpid, easily fatigued, had attack of gouty lumbago two years ago and never well since. Right toe is now swollen, stiff and painful, middle toe also pains, right knee rheumatic, and increasing severity threatens to incapacitate him for business.

"Shortly after beginning treatment with me he had a severe fall, bruising his left thigh, followed by stiffness in both knees and rheumatic pain in the left hand. At the end of a month of treatment the gouty pain in the big toe had almost disappeared, the effects of the fall had disappeared,

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and only a trace of other symptoms remained. After two weeks' further treatment he felt so well that treatment was stopped.

"This case is typical of a large number in both men and women which are hard to cure by medical treatment alone. They are always benefited by high frequency currents and may usually be kept freed from symptoms for a long period of time. It has seemed from observations on many cases as if the very first treatment brought them up to their best level from the state of greatest pain and depression. From this level there is no backsliding, but for two or three weeks there is often very little perceptible advance. Then as suddenly as in the first instance further improvement begins and in a month or so the average case is well.

"Another case was that of Miss D., aged 50, a large woman, weighing 287 pounds, but not at all a case of obesity. Aunt died of chronic rheumatism after being helpless for years. Family had a rheumatic tendency. Her hands were badly crippled, knees and joints of feet swollen and painful, she walked but little and with difficulty and was scarcely able to step up a curb two or three inches high.

"The improvement from the first treatment seemed to her remarkable, but it was nearly three weeks before she made much further advance, being treated twice weekly. She was under high frequency treatment from November 10, 1903, to March 20, 1904, and at the latter date she seemed perfectly well, although there still remained a little enlargement of the joint of the middle finger. Now, many months after treatment stopped, she reports continual increase in health and strength and thinks the greatest benefit comes after the course of treatment is over. *This answers the question often asked as to whether the treatment does not have to be kept up indefinitely.*"

Continuing a review of the 1905 contributions to medical journals, we find an article on "High Frequency Currents in Insomnia," by Dr. W. F. Somerville, of Glasgow, Scotland.

"After abundant use of high frequency currents during three years, and after over twenty years in general practice, I have no hesitation in saying that in high frequency cur-

rents we have a most excellent means, not only of calming the nerves of overtaxed persons, but also of giving them a refreshing and dreamless sleep.

"It is not to be supposed that a single application of electricity is competent to produce a ready and prolonged sleep such as we expect from drug hypnotics and opium, but I have every confidence in asserting that after a course of high frequency treatment, varying from twelve to fifty according to the case, it is possible to give relief, emphatically and permanently, to a sufferer from sleeplessness—and, in contrast with the action of drugs, we induce natural sleep without any deleterious effects.

"It is well known that hypnotics to produce habitual sleep have to be continually prescribed, sometimes in increasing doses, and giving rise to unpleasant consequences. By electricity, on the other hand, the sleep resembles that of childhood and is unaccompanied by any headache, disturbance of digestion, constipation or nervousness, all of which we are accustomed to meet in the action of the usual sleep-producing drugs.

"The sleep which electricity induces or lets nature induce, is not only sound but decidedly refreshing. And still further, not only do the high frequency currents promote normal sleep, but, as we who employ them are well aware, they improve the tone of the system to such an extent that our patients are better fitted to resist and to overcome the evil influence of professional, business, educational, domestic, or other cares and anxieties.

"While comparatively few patients have sought my assistance suffering purely from sleeplessness, a great many who have come to me for treatment of various diseases have mentioned that insomnia was a prominent feature of their case. I think I may safely say that in only three cases have I met with complete failure. All the others have benefited to a greater or less degree. Since I obtained more efficient apparatus than my first purchase my results have been correspondingly better. The first case I will now report is myself.

"Three years ago I suffered considerably from sleeplessness, and even during my summer holiday I awoke so early in the morning that I was in the habit, in order to overcome my restlessness, of going out fishing even before the

early worm had appeared. No sooner, however, did I commence with the high frequency current in September than sleep returned to me and I learned to fully appreciate the blessing of a good night's rest. Since then sleep and I are well acquainted; indeed the union is now so profound that the night bell has ceased to disturb it and I rise in the morning thoroughly refreshed.

"The second case is that of a medical friend who furnishes me the following data: "From the middle of July last year until January of this year (1905), it was my misfortune to be subjected to painful experiences, causing me such acute mental distress and so haunting my mind that it was with the greatest difficulty that I attended to my professional work. Midway in this period insomnia developed and I almost invariably lay awake until 5 or 5:30 A.M., when I would fall into a troubled doze to awake again by 6, or at latest, 7 A.M. I refused to take any hypnotic and began to feel exhausted and unfit for work.

"A crisis was reached in January when for more than seventy hours I was unable to secure even one minute of sleep. A severe vertex pain developed and I was at the point of exhaustion and despair. I was just going to resort to hypnotics when you suggested electricity. I at once had my first treatment with you, taking no medication whatever.

"On the night of my first treatment I slept for half an hour and felt a distinct lessening of my nervous tension. On the second night I slept for an hour. On the third I had three hours' sleep, and the agonizing vertex pain had practically disappeared. Daily treatments with the high frequency current were continued.

"My period of sleep rapidly extended until, at the end of ten days, I was able to get every night from six to seven hours of refreshing sleep. Besides the return of sleep, I experienced a feeling of well-being that was indescribably enjoyable, and my capacity for my work and enjoyment in doing it returned to the fullest extent. I had thirty treatments altogether, discontinuing them five weeks ago, and I have had but one sleepless night, a special circumstance being accountable for it. I have otherwise slept soundly and remain in excellent health and mental vigor. I cannot be too grateful for the benefit."

"The third case is that of the widow of a physician, aged

40, referred to me for treatment of alopecia areata of three months' duration. She was very nervous and stated that she suffered greatly from insomnia, taking very frequent doses of kali brom. After 50 applications of general and local high frequency treatment the alopecia disappeared and strong hair, which at first was pure white, was noticed growing from the bald patches. Since then the new hair is becoming black like the rest. But what I wish chiefly to note is that the insomnia to which she was a martyr has completely gone.

"I met her a fortnight ago, four months after treatment was stopped and was glad to learn that despite bereavement and domestic troubles she was still enjoying excellent sleep."

An Episode.—The plight of patients amid the antagonisms of personal medical prejudice against remedies of great value is well illustrated by an episode related to the author in a private letter dated January 31, 1909. We shall cite it to point its lesson to those who need advice.

"Mrs. ——— was at the luncheon and she fears her son has tuberculosis, so the conversation chanced to turn to the subject of the cure of tuberculosis by electricity. A lady present said she knew electricity *could* cure, as she had had demonstration of the fact. Just then Dr. ——— came in and his opinion was asked. He ridiculed the idea, stated that it was *absolutely* impossible, sneered at electricity and alluded to it as the magic cure-all for everything known to exist, from toe-ache to consumption. He takes himself very seriously and struts a good deal, but if he ever wakes up to *what he don't know* he will be a long time recovering from the shock."

The present writer has met this pompous young physician and is aware of the fact that he has had ample evidence of the merits of electric currents in treatment. But to those who accept his influence as a guide to action it matters not whether he errs from ignorance or 'lies from malice. Incalculable injury is done to innocent sufferers by just such members of the medical profession—and they number many thousands and reform slowly. Most of them refuse to re-

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form at all. Truth is an offense to them and they parade their bigotry as a badge of merit.

By an assumption of superior wisdom they hope to impose on their patients their own estimate of their importance, and only too often they succeed. Cemeteries are filled with their dupes, and homes with their trusting and suffering victims. The lash of scorpions could not castigate them as they indirectly inflict the pangs of avoidable pain on others. Every patient is entitled to have the benefit of the best means at the command of the medical profession that will abate or cure disease. In honorable conduct there is no other course open to the physician. Yet many decry electricity, one of medicine's greatest remedies.

Pure science knows no prejudice, and until the medical body purges itself of the narrow prejudices that widely permeate and poison its membership it can hardly justify to the world the name of a scientific profession.

CHAPTER X

HIGH FREQUENCY TREATMENT OF THE PRESENT DAY

Results of Recent Experience. Early Reports Confirmed and Range of Usefulness Extended. (Malignant Disease Omitted.) Removal of Warts, Moles, Acne Pustules, Acne Rosacea, Small Tumors, Facial Blemishes, Reduction of Morbid Enlarged Tonsils, Destruction of Hemorrhoidal Tumors, Reduction of Hypertrophied Mucous Membranes. Healing Without Scar. Rheumatism and Other Cases. The Prostate.

WE have seen high frequency currents tested by many men in the chapters that precede this. We now come to more recent times and the latest testimonies of medical experience with this physical remedy. The chapters together are filled with useful hints to the reader, proofs of what others are doing, and reminders of what he can do himself with the same methods. Were they not of exceeding value we should not grant them space.

In their entirety these chapters form the most complete demonstration of the merit of this medical agent that can be put in print; and in instructive diversity and clinical significance no section of any book on this subject is more important.

The collection here made is unique in extent and completeness, and affords a view of ten years' practice with high frequency currents marked by great mechanical improvements in apparatus, great progress in the determination of precise actions, and a great increase in the number of physicians applying the benefits of this remedy to their own patients.

But it is still new to many. It still lacks the full measure of appreciation the profession should give it. But it needs only the spreading of knowledge of its worth to awaken

every man who has patients to treat to the advantage and virtue of using it himself. What others are doing still others can also do.

All through the yearly reports of clinical work with high frequency currents we have met mention of two grave and long merciless diseases—cancer and consumption. What have high frequency currents done for them?

We have purposely omitted malignancy and tuberculosis from our extracts. Their treatment even, apart from results obtained by it, is complex and not contained within the resources of any one remedial or surgical measure. Even now, when finality of knowledge is far in the future, the competent treatment of a patient suffering from either of these maladies must comprise a therapeutic *chain*, of which electricity is but the strongest link. And as a chain is no better than its *weakest* link, and as the secret of the foe still baffles research, we should not now look to this (or any) book for the last word on this subject.

Research is continuous and unremitting and the current pages of medical journals reflect from month to month and from year to year the attempts at progress that are being made. When triumph is achieved at last—triumph positive and *sure*—the whole world will know it from the flashing wires of the press.

Of the treatment of cancer (other than the “fulguration” method) we shall say nothing in this too limited treatise, though it is estimated that “as many as five hundred persons who have been treated for some form of cancer by various resources of electricity, show every sign of complete recovery, now five or six years after their treatment ceased.”

Of tuberculosis we shall speak further in our chapters on treatment. In this disease extensive and very definite results have been accomplished. If all patients in the advanced and incurable stages—incurable by all the measures of man—are considered in a separate class and their treat-

ment limited to efforts to ease their sufferings, a great deal of confusion will be removed from this subject.

In stages short of these it has been proved possible by joining physiologic stimuli to nature, to improve practically all cases and make permanent cures in a large number, the benefits surpassing those of all other methods of treatment.

From a recent Medical Record we take the following report of warts, moles, small tumors, hemorrhoids and enlarged tonsils removed by a different application of high frequency current from any method of preceding reports—the discharge into the morbid tissues from a needle-point electrode, of a deflagrating intensity of highly concentrated current for broken seconds or fractions of seconds of time. The entire report is too long to quote but is of great interest.

“This concentrated discharge has been found exceedingly useful in the reduction of hypertrophied and morbid tonsils, is practically painless, causes the gland to rapidly shrink, and is followed in from three to five days by complete exfoliation.

“In soft and moderately enlarged tonsils the reduction is entirely accomplished by one treatment. In larger and indurated tonsils and aggravated cases treatment is divided into several sittings to avoid intensity of reaction.

“This method is especially suited to the removal of tonsils in the adult as it obviates the danger of hemorrhage which attends an operation. As proof that morbid tonsils are a menace to health has increased the demand for their removal, and the safe electrical procedure appeals to the majority of patients more than an operation, it would seem that a wide field is open here to this quick and effective method.

“In the treatment of simple acne where each pimple receives a separate spark-discharge from the electrode, as much can be accomplished in a few minutes as would take as many days or weeks by any other methods. The papules shrivel, the contents of the sebaceous glands escape, desquamation is rapid, and no scar is left. It is this peculiar cosmetic advantage of the high frequency escharotic spark which urges its employment on the face. *It never scars.*



PLATE VI.—This picture illustrates the technic for an escharotic spark effect upon a tonsil with the patient seated on the insulating condenser and the electrode grounded to a metallic plate dropped on the floor to attract off part of the current. A proper "grounding" to create difference of potential between the poles should always connect the attracting electrode (or non-active pole) with moist earth by attachment to a gas or water pipe in city offices, as fully taught by the author in several of his previous text books. The floor is a poor conductor for a "ground." This method of reducing enlarged tonsils has advantages over all others. Readers of cases cited in our text will appreciate its importance.

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Moreover, it can be made to remove small areas of scar tissue, with none of the tedium of x-ray treatment of keloid.

The same treatment was applied to two cases of suppurating sinuses from broken down tuberculous glands. One had lasted six months and the other, three months. The escharotic action on the diseased tissues and the highly stimulating action on the surrounding healthy tissues were manifest and healing resulted in a comparatively short time with insignificant scars.

A number of cases of acne rosacea, one of the most mortifying disfigurements that affect the human nose, were treated by this method. One of them was a case of eleven years' standing. The nose was of an immense size with marked nodulation, and had previously received every other form of treatment, including the x-ray, galvanic electrolysis, and scarification.

"Multiple discharges were made over the entire nose during which process large pockets filled with sebaceous matter opened and shriveled, leaving a thick layer of necrosed tissue surrounded by an active area of hyperæmia. This area gradually dried, shrank, and turned blackish. Six days later it began to loosen and was rapidly removed *en masse* without any sloughing. The surface under it was in an active healthy condition of healing and new skin was already rapidly forming on the denuded area. Ten days later the skin was complete. The result was highly gratifying.

"About a dozen cases of hemorrhoids have been treated so far, some of which were unusually severe and one in particular was the worst case I have ever seen. Treatment was successful in every case, and I am firmly convinced that in this current we have a positive electrical cure for both external and internal hemorrhoids—as positive as the radical operation of surgery. The glass tube high frequency method has a minor action but the escharotic treatment results in obliteration and a healed vein.

"In the majority of cases treatment was divided into a number of sittings. It was never necessary to dilate the sphincter, and in sensitive persons the local application of a 10% cocaine solution or a hypodermic, controlled the little pain.

"Internal hemorrhoids were brought down for treatment by suction obtained from an ordinary ear pump run by a motor. By reversing the valve compression was utilized for replacement after treatment. In this manner both retraction and reduction were quickly performed without manipulation, and not only with no pain but the patient was not even aware of it.

"In no case did the treatment cause an hour's confinement to bed or interrupt the patient's daily duties. We believe there is a wide field for this use of this high frequency method. A few illustrative cases will be of interest.

"Case 1. Miss N. H., aged 55; had tonsilitis every winter for many years; for past six years attacks were more frequent and severe; for past two years had irregular cough and expectoration, irregular chills, fever and night sweats, lost twenty pounds in weight, and was about to abandon position as teacher. Chest, negative. Spleen not enlarged. Blood examination negative. Both tonsils were moderately swollen and flabby, and multiple crypts were filled with cheesy deposits and she had chronic catarrhal pharyngitis.

"Moderate high frequency discharges were made over the surfaces of both glands. A week later, Feb. 14, 1907, the tonsils had markedly shrunk, the morbid crypts were healed, the cough had subsided and expectoration was slight. General health had improved; weight had gained five pounds; there were no more chills and fever. Although it hardly seemed necessary another slight treatment was given.

"She was seen again October 15th. Improvement had continued. On exposure to cold and wet had a mild laryngitis but no return of tonsillar condition. Had gained twelve pounds since her first treatment.

"Case 2. Boy, aged 14, weight 94 pounds, was subject to sore throats, behind class at school, irritable, nervous, and mentally dull. Tonsils markedly enlarged, interfering with breathing; some patches, nasal voice; naso-pharyngeal catarrh.

"Both tonsils treated April 2, 1907. Boy reported, not painful. Two days later tonsils were covered with a whitish membrane. Anxious to hurry his return to his boarding school I made a few more light applications. Was seen

again, April 10. Reported expectoration of several masses of whitish material three days previous. Had gained 5 lbs.; noted increase of appetite; had marked improvement in spirits. Returned to school but was seen two weeks later when weighed 104 lbs., a ten-pound gain in three weeks, tonsils were greatly reduced and normal in appearance, and had improved in studies decidedly.

"Case 3. Mr. P., aged 56; many years a sufferer from sore throat; tonsils swollen and several crypts distended with exudates; chilly and no appetite.

"Treated March 28, 1907. The next day both tonsils covered with white patches; moderate reaction after treatment. Seen again April 3; both tonsils markedly reduced in size, surfaces clear of escharotic tissue and appear normal; decided gain in general health. Seen October 15; reported gain in weight, best health in years and no return of tonsillar trouble.

"Case 4. Mr. L., aged 46, had attacks of sore throat since youth; susceptible to climatic changes; always tonsillitis from exposure to cold or wet; frequent tonsillar abscess; last two years attacks more frequent; last two months, continuous; general malaise and no appetite. Both tonsils enlarged and congested; hypertrophied crypts contained mucus plugs and dried exudates.

"Treated only right tonsil, April 10, 1907, with several discharges of current from needle point electrode; two days later it was covered with a thick white layer of necrotic tissue; slight reaction followed treatment. April 15th, the tonsil was clear. The left tonsil was now treated in same manner; cleared in four days; patient reported that he never felt better. The tonsillar stumps remaining were such as usually result from tonsilotomy. Six months later he had gained in weight and general health and had no return of throat trouble.

"Case 5. Miss K., aged 26; acne eruption on face for past six years; extensive; many small papules, pustules, comedos, and pits covering face, including forehead and chin. Had much treatment, occasional improvement, but always embarrassing disfigurement. Albolene was applied, electric massage, numerous comedos expressed, and several papules had the high frequency discharge. These shriveled, leaving crusts of devitalized epithelial cells.

"The same method was applied once a week until the entire face had been treated, a section at a time. Four weeks after the first treatment the face was absolutely free from any eruption and has remained so up to the present time.

"Case 6. Mrs. X., aged 50; had been mortified by acne rosacea for ten years. The nose was enlarged, bright reddish hue and nodular about tip. Dilated blood vessels covered cheeks and sides of nose. Because the application was somewhat painful and patient nervous only a small area was treated at a time.

"The needle-point high frequency discharge was applied every second day for two months. After each application the area treated contracted and dried, leaving small crusts, which loosened a few days later and were then removed.

"She returned home with her nose and face *absolutely cured*. She was seen a year later and had no return of the trouble. Her gratitude was more than she could express, yet an eminent skin specialist had warned against electricity.¹

"Case 7. Mr. S., aged 30; acne rosacea for seven years, with increasing enlargement and deformity of nose; married and had three children to support, and had lost his position "until he could look inoffensive." Nose was of immense size, nodular, covered with pustules, red, and inflamed. Much treatment useless.

"Applied needle-point discharge on limited areas at each sitting for ten weeks, when he was accepted in his former position. A striking result of the physiological escharotic action of an intensely concentrated high potential discharge of current into the hyperplastic tissues.

"Case 8. Mrs. N., mole on right cheek, long, large, disfigured with coarse black hairs. Deadened sensation with cocaine, then treated with needle-discharge till entire growth was shriveled to level of surrounding skin. Next day there was slight redness and swelling. Treated Sept. 5, 1906; was not seen again till Oct. 10, 1907. No scar was visible.

¹ Such "warnings against electricity" are a vicious and common evil in the medical profession. Personal ignorance of proper indications for physical remedies should not permit an honorable consultant to defraud the patient of the benefit of any treatment that he has not learned how to employ himself. The case cited above illustrates many in the author's experience.

On minute examination a small white spot was the only trace left of the former disfiguring mole.

"Case 9. Mrs. W., aged 56; three external hemorrhoids of moderate size; swollen, inflamed, and very painful to touch; four internal hemorrhoids, varying in size from a marble to a hickory nut; inflamed, as was also the mucous membrane.

"For 17 years had suffered with painful and bloody stools, obstinate constipation, headaches, nervous irritability, etc.; various treatments gave but temporary relief; had morbid dread of surgery.

"The external piles were treated first under local anæsthesia. During the application of the needle-discharge they dried up and contracted. One week later healing was complete.

"The internal tumors were attacked one at a time, each brought down by suction obtained from an air pump operated by an electric motor. One was treated every five days and at the end of a month she was completely cured. She had suffered but trivial pain and had been up and around all the time. Seen a year later. Had gained in weight and general health and no longer suffered from constipation.

"Case 10. Mr. T., aged 72; hemorrhoids and strong prejudice against operation. Subject to them since early life; bleeding a dominant symptom always, often severe. There was an internal pile size of walnut, indurated and inflamed; also some prolapse of the mucous membrane. Was feeble and came long distance for each treatment.

"Employed no local anæsthetic, used mildest dosage, and divided treatment into four sittings at intervals of five days. At the end of three weeks a radical cure had been effected. Was seen fourteen months later and reported no recurrence. The reaction from treatments caused him less suffering than the ordinary exacerbations of his hemorrhoids.

"Case 11. Mr. L., aged 70; hemorrhoidal tumor larger than walnut, indurated, inflamed, ulcerated, and prolapsed; rectal mucous membrane ulcerated and prolapsed; bleeding points; has been subject to profuse hemorrhages; lost weight; a great sufferer yet determined to refuse operation.

"No local anæsthetic was employed in treatments, one of which was given at weekly intervals for twelve successive weeks. At the end of that time there was absolutely no trace of the tumor. He had no reaction after treatment and felt better from it. For the last ten months he has continued in regular health."

The research work of independent investigators striving toward the same end is well shown in a paper just published as we write these lines, describing with confirming testimony the action of a high potential current, concentrated to a high density and disruptively discharged with regulated dosage through a metallic point of special device. It is a weapon of convenience and facility, and the interest of it is intense.

"This discharge must be disruptive, hence the resistance of an air-gap is necessary or we would have a convective discharge. In contradistinction to the so-called fulguration method being used in France, my method aims at a higher vitalization of the tissues treated, and not, as in the fulguration spark, at destruction of tissue except lowly organized tissues and cells.

"The administration may be monopolar or bipolar, or by the condensation method. The duration of a treatment is brief—almost instantaneous. It produces a stinging sensation which is well borne without any local anæsthesia. The time to stop the current in an application is determined by primary anæmia, obvious to the sight of the operator. The congestion which follows depends for its vigor upon conditions observed by the careful physician, and he may aim at a gentle reaction with a delicacy of current scarcely perceptible to the sensitive nerves, or at an intense reaction lasting many days. The energy and frequency of treatments is governed by the action we wish to produce.

"Applied to cutaneous conditions we get primary anæmia followed by congestion—either light or heavy, as desired. In the congestive period we have a well-defined red areola with a proportionate amount of heat. This procedure is obviously valuable for all forms of localized pigmentation, sluggish ulcers, and the obliteration of fine

blood-vessels; in the latter case, heavily applied. Superficial tubercular conditions are also beautifully responsive to the same method.

"To mucous membranes we may apply the procedure for a very great number of conditions; to the conjunctiva of the eye, to the nose, throat, eustachian tube, mouth, vagina, uterus, urethra, rectum; and of great value in all. In the female bladder through a Kelly cystoscope it is very practical with a small lamp mounted in the distal end of the cystoscope. All forms of hypertrophied mucous membranes are instantly contracted by this form of intense discharge, and the application for this purpose must be briefer than when only inflammatory reaction is desired.

"Certain conditions of technic, as, a fairly dried surface, are essential. The electrodes must be exactly adapted to the field of treatment and invariably provided with an insulator to direct the spark-discharge from the point of the electrode upon the spot desired. The metallic electrode must be adjusted in its glass sheath so as to secure the definite length of spark that will set up the indicated action.

"Labile applications are made when larger areas are to be treated, and a moderately slow, sliding movement will accomplish the desired result. When heavy currents are employed and the condenser couch is used there will be a white discoloration of the epithelium on mucous surfaces which is probably a destructive process to the superficial epithelium.

"I have rarely found it necessary to use an exciting current greater than 600 watts—120 volts and 5 amperes—this being used with the auto-condensation method and a labile application from the fundus to the cervix in a case of carcinoma of the uterus; the total time of application at different times being from one-half to two seconds for the whole endometrium."

In two successive numbers of *The Scottish Medical and Surgical Journal* (1908) Dr. F. Gardiner reports very extensive clinical tests of x-ray and high frequency treatments, to aid which he was granted a fund by the Carnegie Trust. A few only of his multitudinous cases may be cited here.

"The following cases of rheumatism were treated locally and generally with high frequency currents:

"Case 1. Male, aged 35, subacute affection of joints for some years; very lame; knees, hips and shoulders most involved. Fifteen-minute sprays to the joints produced speedy improvement and at twelfth treatment three weeks after the first, he felt quite well and free from lameness and has remained free from any attack for four years until recently, when a slight recurrence was aborted by six similar treatments given in two weeks.

"Case 2. Male, aged 29; wrists and shoulders mostly, pains fleeting; had been affected two years but never stopped his work. He had only general electrification; fourteen treatments of 10-15 minutes each on condensation couch. All symptoms had disappeared. Remains well for last three years with only slight symptoms in wet cold weather.

"Case 3. Male, aged 30; had rheumatic fever three years previously and has since suffered acute exacerbations, affecting lower limbs chiefly. Sixteen high frequency treatments of electrification and local spray were given in three weeks, with marked improvement but he was unfortunately unable to continue treatment.

"Cases 4, 5, 6 were females, aged about 60; all with chronic rheumatism of fingers and wrists. In each case electrification and the vacuum electrode locally for 16 to 20 treatments resulted in decided benefit.

"Case 7. Mrs. D., aged 32; acute febrile rheumatism in right wrist for three weeks. After temperature became normal treated with high frequency, 30 applications both general and local, during six weeks. Complete cure resulted and in the two years following she has had no relapse.

"Case 8. Miss M., aged 34; recent acute attack in left knee, still painful and lame. Six treatments, local and general, resulted in entire disappearance of symptoms.

"These are typical of the 38 cases of rheumatism I have treated. In most cases the benefit has been great. I am convinced that most rheumatics stop treatment too soon and believe that if treatment is persisted in considerably after cessation of symptoms that recurrences will be less and effects more permanent.

"General debility, the very common condition of 'fag'

with no definite organic mischief, is one which yields most satisfactory results from high frequency treatment. Details need not be given space but over a dozen cases have benefited without one failure. They all slept better and felt more vigor the next day. The method is indicated, like a vacation, to stave off more serious illness and is successful when a holiday cannot be obtained. Applied previous to a change of scene the vacation will double its benefit in these cases.

"Insomnia has many causes. In the case of a man aged 60 who had suffered for some months and slept only an hour at night, twelve general condensation treatments enabled him to sleep four to five hours. In another case of a man aged 65, the insomnia was left as a sequel to pneumonia and twelve treatments produced a complete and lasting cure. No benefit was obtained in a case of a man with valvular heart disease who had six treatments in ten days. A similar cardiac case in an alcoholic had eleven treatments without benefiting the insomnia. Complete relief was, however, obtained in the case of a woman who had suffered for years and lately become a victim to sulphonals. She had sixteen treatments in six weeks, and during this period and for a long time after, no drugs were required as she obtained natural sleep.

"In the course of treatment of other conditions many patients voluntarily remarked that their sleeping capacity was much improved.

"In three cases of nocturnal incontinence of urine results of high frequency treatment were good. One was an excitable girl of ten years who had suffered from this condition since infancy. The spray was applied to the back and front of the pelvic region every second or third day. Immediate improvement followed, and at first each treatment was followed by a dry night. Gradually the effect carried over two and more nights till entire recovery after thirty-two treatments. For the last three and a half years since then she has remained well. A five year old boy had wet the bed from infancy. Circumcision had no effect on the habit. He had thirteen high frequency treatments with a complete cessation of the trouble. The third case was a young man aged 18. He had 8 treatments on one shore leave, he being a sailor, and the improvement lasted some weeks. On a sec-

and leave he had the same number again and seemed to be quite well at the end but has not been seen since. As drugs so often fail in this annoying complaint the tonic effect of this easily used current is well worth notice.

"Our results in dyspepsia are of interest. Case 1 was Mrs. S., aged 40; both ovaries had been removed; was neurotic; pain after eating, with marked flatulence. Had been treated a year with drug remedies. Gave her eight 10-minute treatments in two weeks, wet pad electrode on stomach, opposite pole in hand. Symptoms disappeared and it was two years before she had any serious return.

"Case 2. Mr. J. D., aged 36; suffers from neuralgic pain in region of stomach, worse after three or four hours of fasting. Attacks come on after a chill or overwork. On three occasions in last three years he has had a series of 6 high frequency treatments by pad on stomach varied by vacuum tube application, with a cure each time. On each occasion drugs were first tried but failed and the electrical treatment succeeded. Case 3 was a man aged 35; an alcoholic with some enlargement of the liver. His symptoms were vomiting, pain half an hour after eating, and nervousness. In two different attacks he was treated with six applications of high frequency, with either wet pad or vacuum electrode methods, and with prompt success.

"Case 4. Anæmic girl aged 28; vertigo and pain very soon after eating; Had a total of seventeen treatments during three months. Symptoms abated greatly but have not wholly disappeared. Case 5, woman aged 32; constipation, pain immediately after eating; vomiting frequent. Had 14 treatments in a month, and after an interval of six weeks she had 17 further treatments in a period of 5 weeks. As alleviation was slight she was operated on and several strictures of the colon were found. The patient died. Case 6 was a female aged 30; anæmic, and pain soon after eating. Treated once a week for four treatments. Benefit marked and has been sustained. Similar cases with but one exception yielded good results and all those treated with high frequency currents had previously been using drugs and dieting without improvement.

The *humane* features of the electrical treatment of *enlarged prostate* that are so marked—no anæsthetic, no

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vomiting, no nervous shock, no tedious convalescence, no loss of valuable time, no operation, and no deaths as the result—make it ideal in cases amenable to any of the three or four chief electrical methods in use. Reports of different physicians who have treated from ten to seventy-five cases each and with results that compare favorably with methods more objectionable and hazardous to the patient, establish the advantages of high potential currents. It is possible that within a year the advance from the “galvanic flashes” of fifteen years ago, and cautery operations, to the high density metallic-point discharge now coming into use may develop a technic which will do for the enlarged prostate what it is already doing for a hemorrhoidal tumor. The current is competent to do it: all it needs is the adaptation of its technic to the gland.

“Report of cases: Case 1. Business man, aged 79; for ten years subject to prostatic hemorrhage; residual urine, 3 to 5 ounces; night urination 4 to 6 times. After twelve treatments, prostate soft and patulous, residual urine a few drops, urination natural. Had no return of trouble till he died a few months ago.

Case 2. Physician aged 60; enlarged prostate for ten years; night urination 4 to 6 times; residual urine two ounces. Ten treatments; prostate normal; all symptoms subsided; night urination, once.

Case 3. A very typical case; all urinary symptoms present; enlargement fibrous, constant uncomfortable feeling, very sensitive to touch, residual urine 2 oz. First treatment ten minutes, January 8, 1908. Fourth treatment, Jan. 20, prostate reduced half, night urination 3 times. Jan. 29, eighth treatment, normal size, night urination once, no residual urine, and treatment stopped.

Seen March 29; prostate normal. Seen again September 13th, prostate still normal. Night urination once or none.

Case 4. Brick mason aged 55; fibrous enlargement of prostate; sensitive to touch; difficult urination; up at night 4 to 6 times. Treatment, ten minutes every second day. Before tenth treatment was again examined by surgeon who had made original diagnosis and who doubted use of

electricity. Surgeon stated, "the prostate is gone." 11 treatments in all; night urination once.

Case 5. J. S., aged 86; urine dribbling for many years; prostate exceptionally large; fibrous; urinates many times at night; residual urine 3 oz. Treatments, 15 minutes each, the first on June 30, 1908. At ninth treatment, residual urine 2 oz; prostate reduced half. At eleventh treatment reported urination comfortable. The old man had to come two miles for treatment.

Case 6. Painter, aged 50; prostate enlarged; after eleven treatments, 10 minutes each, the prostate was normal in size; urinary function normal.

Case 7. Salesman, aged 40; melancholia last fifteen months; twelve years ago had similar attack lasting eighteen months. In both attacks genital organs were irritable. Examination found sphincter ani so strongly contracted that could hardly insert finger; prostate moderately enlarged, but extremely sensitive to touch. After three treatments, 10 minutes each, the spasm relaxed and the sphincter was easily dilated. After ten treatments the prostate was reduced to normal size and genital irritation subsided.

The interest of the medical profession in the prostate arises from the facts that every man has one, that twenty to thirty per cent of them congest, inflame and more or less enlarge in men past forty, causing an immense amount of urinary and nervous suffering all of which would be avoided by the simple plan of early electrical treatment in the beginning of trouble; a thing as sensible and feasible as the early treatment of a cold before it runs into consumption: and the further fact that in function and nerve influence the prostate is the "sexual heart" and the "sexual brain." This is quite enough to render its treatment important, and to lead those who have a complaining prostate to attend to its necessities before it clamors too loud. Proper electrical technics have here a field of underestimated service to humanity.

Our next chapter will conclude these clinical reports.

CHAPTER XI

RECENT CLINICAL REPORTS (concluded)

Exophthalmic Goitre. Baldness and Facial Blemishes. Affections of the Eye and Ear. Final Extracts from the Pages of Practice. Atonic Nervous Dyspepsia. Acute Colds. Anæmias. Blood-Vessels and the Heart. Disorders of Metabolism and the Kidneys. Value of High Frequency Currents in Acute Infectious Diseases. Remarkable Results in Mastoid Abscess. Inflamed Glands and Lesions of the Skin. Anal Fissures with Complications. Sixteen Cases of Tubercular Glands. A Case of Periostitis.

EXOPHTHALMIC goitre is a disease not uncommon, and which advances to one of the most pitiful states of nerve-wreckage that baffle the curative resources of medicinal therapy. All varieties of currents and methods applicable to the case have been employed in their turn during the past fifty years, with greater benefit from electricity than other agents, but late stages of the disease resisting all measures except for mere palliation. And now comes the turn of high frequency, and along with it the next higher radiation in electrical waves, the x-ray. This brief extract is condensed from a full article in the Journal of the American Medical Association, March of the present year.

"In not one of the following cases were any unpleasant or injurious effects observed. In every case where regular and continued treatment was given a positive cure was obtained.

"Case 1. Mrs. H., aged 46, nervous and general debility; loss of weight, 40 lbs; hypochondriacal, sleepless, morbid fears: obtrusion of eyeballs marked but not extreme, pulse 115, thyroid moderately enlarged. (Space prevents the long description of the author.) A case of medium severity.

"The high frequency portion of the treatment was an

application of half-inch (counter-irritant) sparks up and down the spine for ten minutes and over goiter for two minutes: also a mild sedative high frequency application through the eyes by direct contact, one minute to each eye. Treated three times a week for four weeks. The x-ray exposures were, medium tube, 10-minutes, 15-inches, gradually shortened to 10-inches.

"The following reactions occurred: After 4th seance, gland swollen, harder, more elastic, sensitive to touch. Shrinkage began a few days later. Similar milder reactions recurred three times. First treatment June 3, 1903; last, July 12. Thyroid then no longer noticeable to eye; palpation detected slight hypertrophy. Early loss of weight in flabby, adipose tissue, later regained in firm muscular tissue.

After first seance was nervous, giddy, and excited for 2 hours; then relaxed and slept. Similar reactions diminishing till after a number of treatments. Appetite, mental condition and sleep improved from first. Seen two months later, had gained 15 lbs., appeared in best of health; sleeping well; pulse normal; mind happy, and no trace of goitre. Seen once a year since and now (1908) has had no return of trouble.

"Case 2. Mrs. K., aged 36; moderate enlargement of thyroid of a year's growth; marked nervous distress; facies anxious; eyes conspicuously protuberant; mind excited, restless, irritable and suspicious; loss of weight and extreme debility; tremors; cardiac disturbance medium.

"Treatment, same as last case, began April 2, 1907, ending May 24. Eye protrusion gradually lessened; thyroid much swollen after third treatment; hard and elastic, followed by steady reduction till nearly normal. Weight lost at first and then gained; nervous reaction after first seance lasted two hours, followed by eleven hours' sleep, sound and restful; improvement began and markedly increased; felt so well, stopped treatment. Some exophthalmus still evident; goitre not visible to eye but evident on palpation. Seen five months later, still improving in established health, doing her work and feeling better than in years.

"Case 3. Miss. A., aged 53; exophthalmic goitre and nervous colitis; neurasthenia six years, debility marked; gave up position as teacher; now unable to go about. Eyes

protuberant, thyroid moderately enlarged, tremors, emaciation, coldness, etc., etc.

"Treatment, same as before but with additional x-ray exposures to abdomen, commencing May 4, 1907 and prematurely stopped by circumstances. Reactions, loss and final gain in weight, marked improvement in all conditions till last seance. Seen September 15, she reported continued improvement and very good health. Moderate exophthalmus and struma remained.

"Case 4. Miss W., aged 36; a chronic hypochondriac with tendency to melancholia; ovaries and appendix out, numerous operations, insomnia, tremors, moderate exophthalmic goitre. She had three treatments, was alarmed at the reactions and declined to continue.

"Case 5. Mrs. F., aged 50; seen October 5, 1905; preceding history of nervous and physical collapse, acute illness with mania and gastric crises; motor deficiencies present, now highly excited, acts like a maniac, unmanageable, eyes markedly protuberant, thyroid hypertrophied to a high degree, etc., etc.

"Treatment, 3 times a week for 4 weeks, then twice a week during a total of ten weeks, but at first unsystematic and interrupted owing to her hysterical state. Immediately after first treatment she thoroughly relaxed and was seized with an irresistible desire to sleep; fell asleep on train going home, and on reaching home slept soundly for eleven and a half hours and on the following day also slept all the morning. This effect followed each treatment for a month. Pulse had been 200; it dropped 50 beats the first treatment; declined steadily afterwards, with sudden drops after each seance; thyroid decreased one inch in circumference after the first treatment; after third treatment it reacted, swelled, and then gradually reduced except during several minor reactions that followed. Eyes improved constantly though more slowly; mental and general condition improved continually from the first; weight increased.

Continued to improve after stopping treatment; ten months later, eyes moderately conspicuous, thyroid palpable but not visibly enlarged, pulse 80, weight increased from her minimum of 98 lbs. to 131 lbs.; all muscles strong and she is "able to do a hard day's work." Seen two years after treatment she remains in the best of health.

Although we have had good results with electricity, and within two weeks saw a case treated by us with static-machine currents in 1898 with complete recovery and no relapse during the ten years, we doubt if medical literature contains any other report of any other remedies equalling the actions produced in four of the above cases. They are remarkable and can only be imperfectly judged from this very condensed extract of a very able report.

To many readers a special interest will attach to the report of the physician in charge of the electrical department of the London Hospital, recently printed in the *Lancet*. Localized baldness and facial blemishes never lose their prominence with those who have them.

"In July, 1904, a physician applied to me to use the high frequency current on his head for alopecia areata of several years' standing, and for which he had "tried everything dermatologists could suggest." I rubbed the glass vacuum electrode over the bald patches till a bright redness was produced, this taking three or four minutes to each patch. He was treated three times a week for three weeks when he left for his summer holiday. In September the patches were much smaller and fine hairs were seen growing in from the edges of each patch. Treatment was resumed about twice a week for two months. Hair was then growing vigorously all over the previously bald spots and by the end of the year he had a splendid head of hair which has maintained its good condition ever since.

"From subsequent experience I have learned that success depends upon the ease with which hyperæmia can be produced by the current, and according as this is easy or difficult we can predict the result in a given case. If redness, even if somewhat induced, fades quickly away, the case is probably hopeless.

"In ordinary and premature baldness, so long as the hair bulbs have not disappeared by atrophy and provided a good hyperæmia can be easily induced which persists for some hours after each application much good of a lasting kind can be accomplished and it is a method of treatment which should be in much more frequent use.

"I have used the high frequency spark in a case of acne vulgaris, and the rapidity with which the unsightly spots disappeared after some half dozen applications was as surprising as it was satisfactory. The cure was not permanent but with occasional applications the disease is kept agreeably under control.

"Another most valuable application of the high frequency spark is on port-wine marks. My first case was a young man with a deep red patch an inch in diameter on his right cheek. I had formerly made attempts and failures with cautery and electrolysis and now tested intensity sparks. I used a metallic point electrode with insulated handle and connected with the top of the resonator. The point was held about one inch from the surface so that a hot white spark discharged on the skin. This was intermittently applied for several minutes until vesication was produced over the entire surface of the patch. There was no soreness afterward worth speaking of, and in about eight days the old epidermis peeled off, leaving a smooth surface, pink from the remains of the inflammatory reaction but quite like normal skin.

"Another case was that of a young woman with several small stains scattered over the left side of the neck and lower jaw. Gentle treatment being desired I used a glass vacuum electrode, holding it a half-inch from the skin and thus getting only a very mild spark discharge. This method is more comfortable but is not so efficient and takes a longer time. The results in this case were also quite successful.

"In the above two cases the capillary vessels were confined to the superficial layers of the skin, and in all such cases treatment offers but little difficulty. But I have now under treatment the most severe case I have yet attacked by this means. The nævus extended over the side of the neck, cheek, orbit, side of nose and upper lip; a vivid red, only partly removed by pressure; too extensive to attempt by any other measure.

"I am not at all sure that high frequency will be completely successful, but each application to a given part is followed by the reduction of the redness after the inflammation has time to subside. In those parts which have been so far treated twice—with time for each reaction to subside—the redness is reduced by at least one-half. The pa-

tient is encouraged and possibly after going over the parts a third time it will no longer constitute a serious disfigurement.

"From such experience as I have had I have no hesitation in saying that port-wine marks of moderate extent and depth can be entirely removed by this method, while the more severe cases can at least be improved, often greatly. The normal texture of the skin is unimpaired, there is nothing at all approaching a scar, thus differing from electrolysis. Moreover, it is under perfect control, and no further reaction takes place than is desired."

Confirming the observations of others that if the hyperæmia of an improved blood supply can be produced as evidence that the follicles still possess vitality, the stimulation of hair growth with the high frequency current is mainly patience and technique, an American physician enables us to present the following cases from his practice:

"Congenital baldness and old age are excluded, the type responding to treatment being the "premature" of idiopathic, neurotic or seborrheic origin, and in addition, all grades of alopecia areata except the desquamative. The high frequency current acts both as a parasiticide and improver of local nutrition. The important object of treatment is the production of a hyperæmia which will last for several hours. Without this effect very little will be accomplished. Cases should be treated two or three times a week. Vacuum tubes of any type may be used.

"Case 1. Female; hair very thin on top of head, right side of middle almost bare, a case of overwork and worry. Treated four months, three times a week with some irregularity. Hair ceased to fall out in a month. Final result was a new growth of hair which appears to be perfectly healthy.

"Case 2. Female aged 20; seborrhœa; hair falling out and very thin; has had ten months' other treatment. High frequency irritant needle-sparks from vacuum tube electrode were applied twice a week; at end of two months hair had begun to grow. Treatment was continued irregularly for eight months by which time the hair had become very thick

and steadily growing in length. Oily condition much less marked.

" Case 3. Female, aged 33; alopecia due to seborrhœa; hair very thin and short. Routine treatment had been applied and failed. High frequency treatment proved efficacious in three months.

" The results of treatment in cases of baldness due to seborrhœa depend in part on the severity of the disease and in part on its duration. The writer has become convinced however, that good results are always obtained if treatment is continued long enough.

" Case 4. Male, aged 25, alopecia and dandruff; had progressed for two years till hair at top of head was extremely thin. For three months was treated twice a week when new growth of hair began; then treated once a week. At end of seven months had entirely recovered his hair.

" Case 5. Male, aged 23; hair very thin on top of head; made no improvement for five and a half months; then the hair finally ceased to fall out and is now growing abundantly.

" The two following cases indicate that there is encouragement for apparently hopeless conditions:

" Case 6. Male, aged 38; had been gradually losing hair until vertex and temporal regions were practically bare. High frequency treatment twice a week for nine months resulted in a good growth of the hair.

" Case 7. Male, aged 40; hair very thin over temporal regions and only a light downy growth on the vertex. Applied high frequency and stimulating lotions. For six months not the slightest improvement took place. He had no confidence in the treatment and was irregular in attendance. It was only by discontinuing his hair tonics and assuring him of ultimate success, that he could be induced to persevere. A few weeks later a heavy growth of white down made its appearance and he attended thereafter with great regularity. Now a good growth of hair is in progress.

" Case 8. Female; scalp appears healthy; hair very short but thick; almost every hair split at end and short pieces breaking constantly. Gave high frequency four months; hair still splitting but growing longer.

" Case 9. Female, aged 28; neurotic and poor general health; total alopecia areata. High frequency treatment to

right side of head only, every second day for four months, when a good growth of hair was in progress. On the untreated left side hair showed some tendency to grow but was only a white down. The entire scalp was then treated. At end of seven months the hair on right side was 2 inches long and on left side it was $\frac{3}{4}$ of an inch in length."

An article on high frequency currents on eye and ear just contributed by a Philadelphia physician contains the following items for our notice:

"The experience of the writer was obtained with the discharges from the ordinary commercial glass vacuum-tube electrodes, and in all lines of work in which I have tested them I am led to believe that the high vacuum tubes are the most effective therapeutically. These at present seem to be made only to special order.

"From them we obtain the action of a chemically active light, as is proved by the effect on a photographic plate, and though less penetrating than the x-radiation from a still higher tube, is not to be deliberately ignored when we account for its therapeutics; as is demonstrated in recent congestions and inflammations and in circulatory stasis—conditions which are relieved quickly and surely—and in chronic lesions of the same order, not alone of superficial structures, but of the deeper tissues, as demonstrated in a case of musculo-spiral neuritis of long standing, permanently relieved after five treatments at intervals of a week.

"This action is also demonstrated in the deeper lesions of the middle ear and Eustachian tube, as in the case of a woman of 50 who came to me with a marked gouty diathesis and a loss of hearing in one ear, the other failing fast. Examination of left ear showed deafness to be due to sclerotic changes in the drum and obstruction in the Eustachian tube. Similar changes were beginning in the right ear, the hearing in which was about one-third normal.

"Treatment has stayed the gouty process, held it in check for the past seven years and improved the hearing in the right ear, despite the general nervous breakdown of the woman into a chronic invalid state. So much for the ear.

"In the deep structures of the eye the action is shown in a case of hemorrhage into the vitreous, complicated by a

hyalitis in a young woman of 22, a teacher; rheumatic tendency; no specific history or traumatism. Left eye suddenly became blind with no pain or other symptoms; vision, right, 15-20, and left, 15-card. Ophthalmoscope showed vitreous hazy and nerve could not be seen clearly through it; it was like looking through a dotted veil; on quick motion of the eye the appearance resembled a handful of mud thrown into clear water.

"Prescribed rest, glass for well eye, and an internal remedy. Applied high frequency with vacuum tube 7 mm. diameter over the lids for three to four minutes, three times a week at first and then once a week. Rapid improvement took place and at the end of two months the vision was normal. Seen five months later; no return of trouble. One year later she had a hyalitis which subsided in seven days under the same treatment. That was a year ago and she has had no signs of return up to date.

"In all rheumatic or gouty conditions of the eye and ear I have found high frequency an ideal adjuvant to the regular line of treatment. I have several cases that have periodical attacks of deafness in one or both ears, and a few treatments with the vacuum tube discharge combined with pneumo-massage of the drum carries them over the intervening months comfortably.

"From eight years' experience with the use of vacuum tubes I would summarize as follows:

"For electrodes I use the various sizes and shapes adapted for the work and without any internal wire, as I have found that tubes with internal electrode cause too much motor and sensory disturbance to the eye and ear patient.

"As to degree of vacuum, I prefer one sufficiently high to produce a blue luminosity instead of the low-red or pink vacuum.

"Connection of tube to generator should be made with negative pole, which is the richest in the most chemically-active energy, as can be distinguished by the fact that at the point of contact with the patient the cathode lights up with a characteristic pale green light, which does not appear when attached to the positive pole. This affords us a radiation of as short and high frequency vibratory waves as can be obtained, which are chemically very active as they will produce an image on a negative in a few seconds only.

"In conclusion: this particular form of high frequency discharge is useful in all conditions of the eye, ear, nose or throat, in which a gouty or lymphatic diathesis is present:

"In circulatory disturbances where there is need of a stimulus to the circulation:

"In acute and chronic suppurative conditions and inflammations of the middle ear:

"In incipient cataracts, where, judging from the physiological and pathological conditions of the eye it should be the ideal treatment. In my experience it has proved of marked benefit in delaying the formation of cataract and improving vision.

"Also, the post-operative treatment of adenoids and hypertrophied tonsils, to assist in the regeneration of affected mucous membranes and hypertrophied tissue not removed."

As the treatment of the eye is of great interest even if but few of its grave faults can be corrected by therapeutic agents, we give place here to extracts from the experimental work reported by L. Webster Fox, A.M., M.D., Professor of Ophthalmology in the Medico-Chirurgical College of Philadelphia. This report was published in 1907.

"My friend, Dr. Coover, of Denver, first called my attention to his success with high frequency currents in treating a certain class of eye diseases. Following his suggestion I had my chief of clinic select a variety of eye cases, from blepharitis marginalis to atrophy of the optic nerve for tests, and the treatment was then carried out by the chief of the electrical department.

"The applications were made directly to the eyelids with a spiral vacuum tube electrode, or directly to the eye-ball by specially devised vacuum electrodes. The current was taken from the Oudin Resonator. The majority of cases were treated three times a week, though a few had daily treatment in certain conditions.

"The length of treatment varied from two to twenty minutes, and each patient was kept attending for treatment until I felt assured that no further benefit could be derived.

"One hundred Cases of Blepharitis Marginalis were treated. It was gratifying to note that while, with children

afflicted with this inflammation of the eyelid, the treatment was more or less difficult to carry out, yet the cure in all was rapid and apparently permanent. Applied current through spiral vacuum electrode ten minutes daily for two weeks. No failures in the 100 cases.

"Five cases of Iritis were treated; three specific, two rheumatic. Relieved pain but no reduction of the iritis. In one case, where the supra- and infra-orbital pains were intense and nothing but dionin relieved the pains before the application of the current, the effect of ten minutes of high frequency during the painful attack was magical. It gave instant relief which lasted three or four hours.

"Amblyopia toxica from tobacco and alcohol. Three cases were treated, the high frequency current—10 to 20 applications—aiding materially in rapid restoration of vision.

"Ten cases of Retinal hemorrhage were treated; one from injury, four from anæmia, and five from albuminuria. Eight improved after two to four weeks' high frequency treatment. Two cases of albuminuric retinitis associated with marked arterio-sclerosis and optic neuritis did not clear up and the local treatment was of no avail. The arterial tension was 200 cm.

"Three additional milder cases are still under treatment and are benefited temporarily.

"Ten cases of Amblyopia exanopsia were treated. It was to this class of cases that my attention was first called by Dr. Coover a year ago. I can confirm his observations, published in the Medical Record, in every detail. The younger the patient the more rapid the recovery. My youngest case was six years of age.

"One case, aged 52, engineer on Penn. R. R., had a marked squint besides. The eye was straightened and three days later the high frequency current was applied to the amblyopic eye—daily for a month, spiral glass vacuum electrode—3 to 15 minutes at a treatment. The result obtained with his uncorrected hyperopia was from 15-200 to 20-50 and with a correction of + 1.50 Sph. to 20-40.

"His left eye had a hyperopia (farsightedness) of + 0.50 and vision equalled 20-20 without the glass. As an old employee he was retained and is still at work.

"From my experience with these ten cases of amblyopia

exanopsia I am quite sure that we have a curative measure in electricity much more simple and radical than the fusion method with the amblyoscope. I have found that it requires great patience to train small children, and even well-grown boys, to practice with and to use this instrument and I predict that it will soon be relegated to that ophthalmic graveyard where so many 'instruments of precision' lie buried."

This report covers a number of other conditions, some not amenable to electrical action, some calling for galvanic rather than high frequency currents, and some in which more experienced judgment in the direction of the current would have turned failure to success. But we cannot give them space. In the discussion of this paper the following points were brought out by physicians present at the convention at which it was read:

Dr. B. "I had a case of optic neuritis which had been treated by other methods for three months without result. With the high frequency current I gave 6- to 10-minute applications every other day and completely relieved the neuritis in two months. Another interesting experience was that of a boy who had been completely bald for two years. I began high frequency treatment two months ago and the head is now almost covered with hair. In another case of alopecia of not so long standing a half dozen treatments gave complete cure."

Dr. S. "I have had experience with a number of cases in which the eyes had not been properly refracted for glasses, and in some of which there was astigmatism, causing headache and eye-strain. The current through the vacuum tube sets into activity the cellular structures of the eye, improving local nutrition, and relaxing the ciliary muscle, and relieving the tension and strain.

"From my experience with one of my own children I have come to believe that by this means children with slight errors of refraction can be carried through adolescence without being handicapped by the wearing of glasses. I believe that by the correction of these slight dispositions to contraction and strain in improper uses of their eyes or overwork,

in children, which take the eye out of its natural form, we can eliminate the possibilities of more serious errors."

As everybody has a pair of eyes—subject in the course of life to abuse, pain, dimness, injury, and inflammation—we present just one more brief extract from a very practical article, premising that if high frequency currents had no other benefits to offer the eye *their use as a mere tonic and strengthener of vision* when the strain and wear of time dims the once clear sight and handicaps the owner ten, twenty, and gradually thirty per cent of his ability to see, would alone make this simple measure a boon to every ageing physician on his own account, and the means of his conferring the same blessing on his patients.

"Dr. W. considers high frequency currents and the x-ray as almost indispensable in treating diseases of the eye and ear. In iritis he has not seen a case that was not favorably affected by high frequency treatment, it both relieving the pain and reducing the inflammation. In one case of rheumatic iritis the pain was so severe that the patient had not slept for two nights. H-F vacuum tube discharge with a flat-surface electrode attached to negative pole and applied over the closed lid gave such complete relief from the pain that the patient fell asleep while being treated, and recovery from the attack was rapid. She had been subject to recurrent attacks, but since this treatment she has had no recurrence.

"In earache and neuralgia he has found high frequency valuable for relief of the pain. He places the electrode over the mastoid, or applies the current in some cases through a roll of wet cotton placed so that it is against the drum."

An extract from a paper read before a meeting of a medical society in 1908 by a physician practicing in the South presents points of interest in the actions of high frequency currents:

"Thirteen cases of anal fissure, seen in various stages, were treated. In the earlier cases the local inflammation

was quite marked, while in some of the more chronic cases ulcers of various sizes were present. All but one case had external piles, and all had excoriation of the buttocks and itching.

"All got well and in no one case was treatment continued longer than two weeks. One particular case was as follows: The patient (a woman) had cut the rectum and caused the fissure with a new syringe used five days previous to move her bowels. She had excruciating pain on now attempting defecation, was highly nervous, abdomen distended, urination painful and frequent and marked itching of the parts. Attempts to first relieve the locked up bowels by castor oil enemas, etc., and the pain with morphine suppositories, were unsuccessful. A 10% cocaine solution failed to ease the pain of divulsion, which gave no relief. She refused operative measures. She was then treated with high frequency twice a day for the first two days, and then once a day for a week more. Relief was marked after the first three treatments and at the end of a week there was absolutely no sign of discomfort or of the condition which had caused it. This was over a year ago and she has never had the slightest return. (Had the case been chronic it would have taken a much longer time to correct the condition.)

"She was treated as follows: The patient was placed on an operating table, an insulated glass vacuum electrode was passed through the sphincter, which had previously been dulled with a 4% solution of cocaine, and the opposite pole of the current grounded. Treatments lasted for twenty minutes except on one occasion when rectal irritability ensued.

"Sixteen cases of tubercular glands in the neck were treated, twelve of them having only high frequency currents, while four of them had some softening which called for curettage and drainage besides the electricity. One case will illustrate the treatment.

Mrs. F. S., aged twenty years, weight 98 lbs., noticed two years ago that her collars were getting tight and neck movements painful. Shortly afterwards one of the neck glands was swollen and pain extended down the shoulder and axilla. Her physician prescribed the usual syr. iodide of iron, painted the gland with iodine, put her on tonics,

fresh air, sunshine, etc. The gland increased in size and finally prevented opening her mouth.

"When seen by the writer the jaws could not be separated enough to insert a tongue depressor. She had no throat symptoms. There were two broken down glands one on each side of the neck, which were opened by an incision a half inch long, curetted and packed with iodoform gauze.

"The high frequency current was then applied through the neck with a glass vacuum electrode on each side and a stimulating alterative dosage applied until the skin was red with fresh blood supply. This was done daily except for a few days when the skin became too tender. At the end of one month the glands had disappeared, the patient was able to open her mouth freely and widely and with ease. This was fourteen months ago and she remains well since then.

"I will next report a tumor of the breast. Miss E. R., aged 29. Three months ago noticed pain on raising her arm and a week later had a tender swelling on her breast. This increased in size. She was treated every second day for three weeks when both breasts were the same size and no tenderness or evidence of the swelling remained. The glass vacuum discharge and a spray application were alternated on successive days of treatment.

A case of periostitis was Miss E. M., aged 32, single and a school-teacher. She had suffered from a periostitis of the tibia for three years and treatment by several surgeons was without benefit. All had advised operation, which she refused. She was now treated with a high frequency current three times a week. She could soon take longer walks, stand longer on the limb, and was relieved of the severe pains. Each treatment lasted from fifteen to twenty minutes, using the glass vacuum electrode. Nearly a year has passed and she has had no further trouble with the leg."

We close this section of our book (a section entirely unique in the literature of high frequency currents) by a general extract from a recent publication of unusual interest:

"In several cases of atonic nervous dyspepsia Ewald-Boas test meals were eaten prior to treatment and analysis showed complete absence of pepsin, peptone and hydrochloric acid in the stomach. The next day the test meal was repeated, a high frequency vacuum electrode treatment given over the stomach for ten minutes, followed by five minutes of the motor wave current with block tin electrodes over the solar plexus and dorsal spine.

"An hour after this stimulus to the secretory and vascular mechanism the contents of the stomach were removed and analysed, the result being an almost complete peptonization of the coagulated albumen. Daily treatment for a month effects a radical cure in the majority of cases.

"Disturbance of the equilibrium between the cardiac and vasomotor systems may flux the blood in the larger vessels and deplete the peripheral vessels, causing pallor and coldness of the surface of the body, with a tendency to chills, thereby lowering the vital resistance and predisposing the tissues to the infection of germs. Fully nine-tenths of our acute diseases result primarily from the above sequence of effects from congestion to inflammation, the initial anæmia of the surface capillaries being due in most cases to a reduction of the nervous energy of the great centres which supply the vasomotor system and keep it regulated to normal balance.

"No other agent known to the medical profession will produce such immediate and direct effects upon the vasomotor system as the Tesla high frequency current. In the condition just described the surface anæmia and chilliness give place to a healthy warmth and glow within five minutes after the application of the Tesla current.

"Even when serious disturbance of the vasomotor system is present, as in the initial chill of lobar pneumonia, prompt and vigorous use of this current, either by the sharply counter-irritant frictional discharge from a glass vacuum electrode, or spray, or the wave current method, will destroy the toxæmia, break up the superficial chill and fever and actually abort the disease.

"The patient will break out into a profuse perspiration and the pulmonary congestion will change its character so that a mild catarrhal inflammation replaces the virulent pneumonic infection."



PLATE VII.—Illustrating the interesting technic of localizing auto-condensation effects through the stomach and nerve supply by interposing the high resistance of a thick glass plate between the electrode and the body. The "condenser" effects are very marked. The method may be used in a variety of dyspepsias and other conditions marked by loss of tone in the abdominal organs.

"In secondary anæmia and chlorosis general high frequency treatment is of great value in stimulating the regenerative forces to the production of new blood cells and increasing the oxygen-carrying power of the red corpuscles. Auto-condensation with the addition of vacuum tube applications over the spine and solar plexus, will usually bring about a progressive increase in the strength and activity of the vital functions.

"In a majority of cases diseases of the blood-vessels are amenable to treatment by high frequency currents. The walls of veins and arteries when weakened by disease are strengthened by high frequency currents, which not only aid the natural regenerative work of the leucocytes and elements of the blood and lymph, but by their stimulation of the vasomotor system they relieve the weakened walls of undue pressure and tension and promote the return of normal elasticity.

"In this manner beneficial results may be produced in simple and rheumatic purpura, varicose veins, phlebitis, aneurism, and arterio-sclerosis. General treatment by use of the vacuum chair, or regular vacuum electrode over the solar plexus, together with auto-condensation, are best methods of treatment. A number of cases of arterio-sclerosis have been reported as successfully treated by general electrification with high frequency currents.

"Tesla currents are often of great value in organic heart disease in assisting nature to establish compensation. In later stages after compensation fails the current is palliative treatment through its action on the vasomotor system and its tendency to disperse dropsical effusions.

"In acute colds which may develop into either coryza, or bronchitis, or more serious affections, the Tesla current will usually give prompt relief if applied in the early stages of the attack when the symptoms are those of disturbed equilibrium in the blood-vessels, congestion of the nasal mucosa, with a profuse watery discharge, chilliness, alternating with fever, etc.

"While diabetes, gout, uric acid conditions, and obesity differ in their general symptoms they are closely allied, being the results of some local or general interference with the nutritive and metabolic processes of the body. General high frequency electrification is beneficial in all these diseases,

and should be given daily. Local treatment with the Tesla currents should be given in addition, applied over the spine and solar plexus.

"One great advantage of high frequency treatment is the absolute impossibility of its producing any effects which interfere with any medical treatment. On the contrary, by their action on the circulation and by their stimulation of vital function, high frequency currents actually increase the therapeutic efficiency of all varieties of medicinal agents.

"When diseases of the kidneys result from deranged metabolism high frequency treatment will usually restore them to a normal condition by removing the exciting cause. If active renal congestion occurs in the course of other diseases it may usually be relieved by Tesla treatment with the glass vacuum electrode and a metal plate over the solar plexus. Passive renal congestion is usually of a subacute or chronic type and should be treated with the same methods.

"In organic diseases of the kidneys, with actual degeneration of the tubular epithelium the Tesla currents are of the greatest value. Cases of acute and chronic nephritis, both the interstitial and parenchymatous varieties, have been successfully treated in the writer's practice, by the application of the Tesla currents to the lumbar region, the effluve and vacuum electrodes being used, each for ten minutes, followed by direct application of the d'Arsonval current by means of sponge electrodes. General treatment by the Tesla wave current used alternately with d'Arsonval auto-condensation should follow the local direct treatment just described.

"Renal colic may be frequently relieved and the passage of calculus through the ureter facilitated by sparks (as from static machine) applied in front or back according to position of the stone. Persistent gleet may be permanently cured by a high frequency application through a urethral vacuum electrode of high exhaustion (white discharge).

"Functional impotence from excesses, or of nervous reflex origin yields readily to high frequency treatment.

"In pyelitis, pyelonephrosis and cystitis, a metal olive insulated urethral electrode is inserted into the bladder and connected to one terminal of the high frequency current.

The other terminal is connected with a vacuum tube electrode which is applied over the surface of the organ affected—kidney or bladder.

"In acute catarrhal cystitis the treatment is the same. In cystitis from gonorrheal urethritis a vacuum electrode shaped like an ordinary sound is inserted and an ordinary vacuum electrode applied externally over the bladder.

"Acute gonorrhea and persistent gleet may be cured in the same way, but in an old gleet the penetrating action of low-grade x-rays as well as the ozone discharge lead some to advise a high vacuum for the electrode instead of the low vacuum used in all acute inflammations.

"The value of high frequency currents is even greater in acute infectious diseases than in chronic diseases in which so far they have been most used. Prompt Tesla treatment with the effleuve applied alternately to the spine and solar plexus, followed by a general application of the wave current will actually abort many varieties of acute infectious disease if administered sufficiently in the attack.

"In the prodromal stage and period of incubation treatments should be given twice daily. In the acute stage with chills, fever, headache, nausea, etc., fifteen-minute treatments should be given with a half-hour between them until the fever subsides and the patient breaks out in perspiration.

"In severe cases of mastoid abscess with cerebral and pyæmic symptoms, a vigorous thirty-minute treatment with a high vacuum electrode externally and a metal electrode in the patient's mouth, produced an absolute dispersion of the acute manifestations, the patient sleeping naturally inside of five hours.

"The next day the pus was evacuated and although cover-glass preparations showed countless numbers of streptococci and staphylococci, only a few scattered colonies were obtained in a plate-culture on nutrient gelatin.

"Cervical adenitis and tuberculosis of the lymphatic glands have been successfully treated by the above method, which also is applicable to almost any type of subacute inflammation accompanied by hyperplasia.

"Diseases of the skin of a subacute or chronic character resulting from, or associated with, diseases of the digestive system or nutritional derangements, are almost without exception amenable to high frequency treatment."

With this we conclude these very informing reports of what is actually done with high frequency currents in various countries. Notice that these reports are not "*claims* of what *can* be done" but they are statements of what *has been done*. In this respect they refute critics and the common type of criticism of electric currents in medicine. Every page will repay study. Every chapter will profit the physician who reads it, and will be especially useful when reread in connection with the directions we shall give for treatment of the same conditions in Part IV.

In the next chapter we begin our consideration of high frequency apparatus and the principles of administration and dosage that form the foundations of correct treatment.

PART III

The Consideration of Apparatus and Principles of Administration and Dosage in High Frequency Treatments

CHAPTER XII

HIGH FREQUENCY APPARATUS AND REQUIREMENTS FOR TREATMENT

The Essential Facilities Needed by the Physician. Resources of Special Currents. Chief Methods of Use. The Great Scope of Technique. General Electrification by "Auto-Condensation" Explained. Rules for Treatment. Discharges Modified by Glass Vacuum Tubes. Directions for Dosage and Uses. A Chapter of Special Instructions.

THE writer, long familiar in practice with the medical uses of galvanic, faradic, sinusoidal, and static-machine currents of electricity, became interested in the high frequency type of medical current in 1901. Before that date the only attempts to provide physicians with resourceful and efficient high frequency apparatus had been made by European inventors.

The awakening of home manufacturers to the needs of the profession was one of the important results of the writer's fifth text-book of instruction, published in 1902, which contained a section on high frequency currents, the first to appear in a treatise by an American author. It is interesting to note that for several years past American makers have taken the lead in this field and now produce apparatus of the very highest efficiency.

At this point in the usual treatise on medical electricity most authors begin some four to six chapters on physics and apparatus—sawdust for the reader who has read it before—useless in a book like this—chapters for study in an elementary treatise—and we shall omit them.

After a short account of some primary details which can be of interest and value to every one, we shall at once pass to the essential foundation subject of the medical actions

of high frequency currents which justify physicians in their use and give them value in the treatment of disease. *On the data we shall then set forth is built the whole structure of the medical prescription of this form of electricity.*

What we shall now say about apparatus will be confined to general principles, for experience convinces us that a physician should look directly to manufacturers for commercial information, while a text-book should devote its limited space to teaching. It has long been customary with writers to present a survey of all the leading catalogues and dealers in the field, but we shall depart from time-honored custom in order to save our pages for clinical matters.

In order to obtain high frequency currents for medical use it is necessary to possess a primary apparatus furnishing an electric current which is competent to be stepped-up to the required tension by being passed through a suitable transformer connected with it, for the high frequency transformer is a secondary apparatus made for attachment to the generator or source of current.

Galvanic and faradic batteries are entirely out of this class and do not supply the physician with any basis for high frequency treatment. But there are three mechanical devices which serve the purpose, and thousands of physicians employ one or the other of these. They are the static machine, the Tesla x-ray coil and the Rhumkorff x-ray coil. All of these are operated on either direct or alternating street lighting circuits.

A given instrument of either variety may be smaller (for the sake of so-called "cheapness") than an efficient size. An instrument originally effective may be reduced to half its value for treatment by neglect, and failure to keep its parts in working order. The transformer itself may be any one of a dozen models, each furnishing different relations of volume, tension and frequency of the discharge.

This variety in construction, quality, and capacity of apparatus means that different physicians with different apparatus will differ in their work with their patients, will

obtain varying results not all of the best, and will establish for themselves different opinions of the value of a remedy which they call by the same name. The writer has used in his private practice the high frequency apparatus of four different manufacturers and speaks from an enlightening experience on this point. One device is excellent for skin diseases but is good for little else: another operator may use an instrument with a high general efficiency for every form of application, and naturally reports of the physiological tests and clinical results of these two men will disagree.

The improvements in electrical construction have also put *portable* high frequency apparatus on the market of a quality undreamed of five years ago. They are relatively efficient, have an undoubted field of usefulness and range in price from \$50.00 to \$100.00 or more. They are coil types.

Non-portable apparatus for office use and hospital service have become works of art in construction. The primary appliances cover all medical types. If the static machine is used it must be large enough to generate an efficient current, and the difference in the high frequency discharges from the same high frequency transformer attached first to a ten-plate machine and then to a sixteen-plate¹ machine is so marked as to discourage a skilled operator from using the smaller current. Efficiency requires an ample dosage.

In the combined x-ray and high frequency coil appliances makers of such instruments to-day reach the high water mark of electro-therapeutic development. We long held as an heirloom a primitive magneto-electric battery made about 1845. The small box affair was the best of that pioneer age. But what a stride between the two! The giant coils of these high frequency times are the mature growth of the infant faradic battery of Duchenne, and how one of them would surprise that stupendous Frenchman, the greatest investigator of his day!

¹ The author refers only to 10 and 16 *revolving* plates. A 16-plate machine has 32 plates in all.

Complete equipments of non-portable high frequency apparatus range in price from \$250.00 to \$1,000.00. The cheapest are not the best.

It is an advantage to the physician who begins the study of high frequency currents to have previously had experience with other currents so that he is well grounded in the principles of general electro-therapy. "High frequency" will then simply appear to him as an old friend in the guise of an altered dress but with the strong resemblance of familiar actions. Electrical terms are then understood, the elementary basis of indications is known, general technics are mastered by the hand, and the perplexities of the novice over A. B. C., and other things equally simple and clear, are past. But if the beginner lacks this experience a few remarks here will help him to clarify his reading of journal articles and specialists' reports on this current.

First, all the six familiar medical currents of electricity possess characteristics and properties *in common*. Each has its place and special actions of choice and convenience, but if we take the actions of each current as a whole and compare them side by side we find that they overlap each other in a considerable part of their clinical work. Writers who know but one current fall into errors of statement which mislead the novice, and one of the best ways to educate the judgment is to get a standard book on the electro-therapy of a dozen years ago and read the chapters on actions, and uses in treatment, of the currents then employed.¹

Another thing to remember is the distinction to be made between the medical value of a given form of *current* and an *apparatus* said to supply it. Here we put our finger on the plague-spot in the history of electro-therapeutics. The static-machine current is a great current of magnificent properties, but for many years nine out of ten machines

¹ The most complete information to be found in one treatise on galvanic, faradic and static machine currents may be obtained in "The Treatment of Disease by Electric Currents" by Dr. S. H. Monell, written in 1897. 1100 pages.

sold were below the normal standard. The faradic current is superb if it is derived from a set of high tension induction coils with a complete switchboard for dose regulation and selection; but the common cheap so-called "faradic battery" is fit only for the rubbish heap.

Despite the great merit of the faradic current it would have been better for the reputation of electricity if the induction coil had never been discovered by physicians until it matured into the full grown high frequency coil of the present day. No matter who uses the cheap appliance it can never be anything but a quackish and dishonest device, utterly unworthy of a scientific profession. And the principle still holds good with high frequency currents. Unless the apparatus is what it ought to be the current generated will disappoint. Let us now consider high frequency actions.

High frequency currents have so high a voltage that they have great power of penetration. The small resistance of the body is as little obstruction to them as a slice of cheese to a rifle bullet. Hence, if we conduct the current into the body and let it find its own way out it will charge every portion of the tissues with the amount that collects before it breaks through the skin and overflows.

This *general electrification* of the whole body produces general systemic effects in contrast with the *local* application of the current for local effects. This general treatment requires no removal of clothing and could be given to a man in an overcoat and rubber boots as well as to a lady in a summer shirt waist, but local applications require an adjustment of the resistances in the circuit and this often means that the electrode must be in contact with the bare skin of the part treated.

High frequency currents are spoken of in the plural for the reason that a competent appliance supplies, for the purposes of dosage and differences of action, a number of discharges of widely varying frequencies. The most complete equipments are nearly a dozen "batteries" in one, affording the physician a choice in treatment, of monopolar and bi-

polar currents of high, medium, and relatively low potential, and high, medium and relatively low frequencies; and in addition, means of emulating sinusoidal, faradic, and static induced methods; the spray, the spark, and general and local electrification, as well as cautery currents, x-rays, and violet and ultra violet radiations. When the variety of electrodes is also considered it will be seen that this appliance is a veritable arsenal of weapons in the hands of progressive physicians who master it.

For those who are unfamiliar with the way these currents may be made to act we will first cite two or three of the interesting popular experiments and then describe the uses for which the different discharges are designed.

When a person is connected to the high potential terminals of such an apparatus the stream of current from the terminals flows into his body and *collects* there until its capacity overflows, about as water running from a faucet into a basin will collect in the basin till it also overflows. This accumulation of current in any body that will hold it is called "condensing" it, and in the case of the human body the "condensation" of the current "charges" the whole person so that it is "electrified," and remains so till we stop the flow. While this "condensation" treatment is going on there is a continuous overflow, as the body will hold only a small amount, and this is escaping to the earth as fast as the inflow from the apparatus presses the "charge" onward.

Now bring a low vacuum tube within two or three feet of this "charged body" and the escaping radiations we have spoken of as the overflow will reach the tube, electrify it, and light it up the same as if it was connected with the apparatus. But the charged person feels nothing. Yet his nerves are feeding on a tonic.

Next, have the "charged" person take an ordinary 16cp electric light by the bulb and press the Edison base against one of the same high potential terminals of the apparatus, and as the current is increased the same "charge" that is



PLATE VIII.—Illustrating method of connecting the pair of insulating pads now quite generally used for "auto-condensation," treatment instead of the couch mattress or chair seat. The picture at the reader's right shows posterior connections, with pads attached to one terminal of the current. The opposite view shows the current from the other terminal in contact with the patient through a metallic electrode held in the hands. While aiming at the constitutional effects of the static machine charge it will be noticed that high frequency electrification does not require an insulating platform. The rapid loss of voltage in the body of the patient makes it unnecessary to bank up the charge by glass legs a foot high.

"electrifying" the body lights up the lamp. Yet the person does not feel it.

Our sensations are largely influenced by the "density" of what hits us. A light tap from a broad paddle is a friendly salute, but condense the same energy into the density of a needle-point and the sharp prick will make a man jump. If we now condense the charge of electricity that is unfelt when it is diffused in so large a body as a man, into the density of a bit of iron wire so small that it crowds the current with terrific pressure to get into it, we witness the conversion of force into heat and the wire turns red, and then burns with brilliant scintillations as the same current flows onward into the body of the person holding the wire.

There is still no sensation in the charged body. But if we condense the same current, and force the entire energy into the body through *small* "electrodes" we find that sensation follows the same rule of "density versus sensation," as with all other currents. No form of electric current is an exception. Certain laws of operation are common to all. We have taught this subject very fully in at least three of our previous text-books for physicians and our limitations of space prevent the repetition here.

We now turn to those modifications in the qualities and characteristics of currents from a complete high frequency apparatus which supply the range of method, dosage, and means of setting up desired actions in the tissues, which make electricity a medical instrument of precision and give us control of its uses and effects. In what follows we shall do away with the French terms which need the familiarity of an expert, and will use plain English as in all our books.

All diseases and all ways of treating them by any or all remedies known to physicians are first broadly classified as "general" or "local." As there is but one "general electrification" with the high frequency apparatus now in common use, while "local" methods are numerous, we will first speak of the great general method which is called "auto-condensation" and consists in charging the entire body of

the patient as we have described in the experiment of lighting the Edison lamp.

For this purpose a current of medium potential and frequency is best used, as too high a frequency reduces the physiological response of the tissues, and an excess of voltage leaks off the charge too fast; for the familiar insulating platform of the static machine is not supplied with this apparatus and the patient sits in a chair or reclines on a couch with only the resistances of skin and air to retard the escape of current while the soft and fluid inner tissues are being saturated with the charge. It is a good deal like holding a stream of water in a fine sieve. If the sieve is fine enough the water runs out slowly and the resemblance to a basin is sufficient.

But we can readily see that the amount of current that will run into the "sieve-like" body of the patient in a given time will also depend a good deal on the size of the stream—the "volume" of the current, measured in the medical units of milliamperes. The volume of the stream may be any quantity from 125 to 1500 milliamperes in a given treatment—but don't turn it on all at once. It is not the design of *treatment* to "drown" a body with water, or burn the patient with applied heat, or over-stimulate the nervous system with an excess of electricity. Begin at zero and gradually increase the final dosage to fit the case—the *medical needs* of the case, as they must be interpreted by the responsible physician who is administering the treatment.

There is one more factor in making the "condensation" dosage act as we desire—*time*. One effect can be produced in five minutes with a given dosage. With a less efficient dosage it may take twice as long. One condition of the patient may demand a fifteen-minute saturation of the tissues before the desired effect is obtained: another condition in another patient may respond sufficiently in ten minutes, or less. The temporary result of too big a dinner is a sense of repletion: the equivalent effect of too much "condensation" at one sitting is a temporary repletion also, usually

manifesting itself in a relaxed feeling of weariness which passes away in an hour leaving the tonic action to mature, just as the good dinner nourishes the tissues after the sense of "stuffiness" passes away. Also, we may remark, that a little bit of *after-dinner high frequency tonic* will far surpass coffee or cocktails to banish the stuffiness, lighten the weight, clear the head, and replace dulness with vivacity and animation. It is a boon to the *bon vivant* and the diner out.

It is customary to use this method in general diseases, especially those associated with suboxidation and deranged metabolism, and a long list of names is cited—diabetes, rheumatism, gout, neurasthenia, anæmia, hysteria, and many others—in which the beneficial action is indicated. But if the physician will turn to our chapter on the physiological actions of these currents and note exactly what general electrification *can be made to do*, he will then be able to make it do the same things for patients who need them, regardless of the arbitrary name of any disease. And in a lot of conditions which disturb comfort without taking rank in the list of formally named diseases the function-regulating properties of this current make it useful, and few people are so well that it will hurt them to be more so.

A first need in the treatment of all diseased conditions whether general or merely local is the induction of physical (protoplasmic) activity to be converted into *physiologic energy* to restore the sound state. All bodies charged alike (with the same electrical polarity) seek to repel each other (*separate from each other*) and in general electrification with a high frequency current we establish this state of physiologic stress in the tissue cells. They take on a tonic tension and become charged with activity.

Now, if we act upon this stress with a series of *stops* and *renewed charges*, making a *periodic* activity intensified by a rapid succession of hammer-blows (oscillations) instead of the uniform pressure of constant electrification we throw the cellular elements of the body into a still more tonic activity

and stimulate their physiologic energies to perform more health-restoring work.

This is accomplished by means of the author's system of *interrupted charge* originated by us in 1893, and since then largely employed by others under the name of "wave current" bestowed upon this method in 1899.¹ In its local and general application this principle of interrupting the electrical charge has fully borne out all we anticipated of its value in our first published account in 1893.

The broad clinical rule that general disease requires general treatment and local diseases require local treatment is only part of the truth, and at each stage of general diseases we are apt to find conditions that call for local as well as general treatment—for both internal and external treatment, and attention to other things besides. Make the therapeutic chain *complete*. Electricity is an important *link* in the chain, but *all* the resources of medical knowledge must co-operate if the best benefits are to result. Some forget this.

Owing therefore, to the many needs of them we have a variety of local methods of setting up localized actions with high frequency currents to meet the indications of diagnosis. As a whole these "local" methods possess great importance and are indispensable.

The most extensively useful local method takes the same current employed in condensation treatment and sends it through the resistance of a *glass vacuum tube* "electrode" which acts upon the volume of current somewhat as the resistance of the small outlet of an atomizer transforms the fluid within the bottle to a spray outside of it. *Pressure* and *resistance* acting *against* each other will do a lot to alter the state of fluids and electricity—and even gases and solids.

Vacuum electrodes are made in various shapes to suit various purposes and are also exhausted to different degrees of vacuum. The low vacuum is most used and is also the

¹ For further explanation of so-called "wave currents," see next chapter.

1. The first part of the document is a list of names and titles.

one indicated in acute localized lesions. The pink discharge seen in the dark identifies this vacuum. The next higher exhaustion gives a bluish discharge and the next higher gives a whitish luminosity. This is used in chronic inflammatory processes such as an old gleet, for the effect of the actinic rays of violet and ultra-violet light mingled with the electric action. A still higher vacuum may be had, giving low x-ray effects along with the electrical actions.

Special shapes of these are also protected with insulation so as to deliver the current only on the area of contact with the diseased tissues, as in the cavities of the body. They are supplied for aural, nasal or throat work, and for rectal, prostatic, urethral and vaginal treatments.

Glass electrodes, among the first to be used and then called "condenser electrodes" are made of hollow tubes filled with conducting material (carbon, etc.) and without any vacuum exhaustion. They deliver more volume of current as they have a less resistance than the vacuum electrodes. They are used in the same ways.

This glass tube discharge of the current is really a nebulized stream of particles but is not used as the equivalent of the static spray. Another electrode is used for that purpose. The three grades of vacuum, low, medium, and moderately high, lend three grades of intensity to the dosage of tube discharges. The low vacuum is by far the most used. The luminous effect is a pinkish glow, and the complex radiation carries to the tissues not only an electrical energy but particles of ozone and chemical light rays from the violet end of the spectrum. What, ten years ago, looked to the layman as an innocuous toy, presents, therefore, to the scientific medical mind *the clinical picture of a great remedy*. Some of the greatest things on earth look simple. This is one of them.

Granted an efficient office apparatus, and assuming that study of actions has taught us what we can make this electrical tool *do*, the next thing in order is to learn how to make the tool do the different kinds of work for *us* that it

does for others. All these medical instruments are simply tools in our hands. They have no volition any more than a hammer has. Take the carpenter from the hammer and how many nails will it drive? So, with electrical curative actions—it is the doctor, not the tool, that must apply the *know how*.

First comes the regulation of current passing into the electrode so that we can get out of the transformed discharge the right intensity for action in the given case. Arrange the patient for treatment to suit convenience and comfort and afford access to the parts, about the same as you would for a local galvanic administration. Other writers discuss various technics, monopolar, bipolar, direct, indirect, etc., and leave the beginner in a sea of doubt as to his choice. A simpler teaching is better practice and prevents confusion.

Connect the patient to one terminal of the current, using either a bare metal handle, or metal plate, or wet-pad electrode, according to convenience in a minor case or effects wanted in an important case. Judgment becomes trained to make the best connection. If the trunk of the body is being treated place the pad electrode on the opposite surface on the bare skin.

Ground the same terminal of the current, just as you ground one of the static-machine poles, to “pull” the current into the patient with greater energy. This makes the work of the discharge from the electrode much more active and increases the effect of treatment.

With the vacuum electrode connected to the opposite terminal and the current at zero, grasp the head of the electrode lightly in the left palm and with the right hand run up the current until the tube is seen filled with a steady luminous glow and the bulb warms the hand in contact with it. This test before applying the electrode to the patient will always show the operator a chance defect or assure him that connections are correct, before there is any possibility of alarming a patient. The precaution takes but ten seconds

and is worth it. The luminosity can be judged best in a partly shaded room or in the dark.

As quickly as assured that connections are correct cut down the current, apply the electrode to the patient and again raise the current from zero to the effective dosage. The application must then be directed to setting up the necessary *action* in the tissues, and this may require the electrode to be moved or held stationary, but the manipulation follows the same principles as taught in treatment with other currents and labile and stabile electrodes. More particular directions on this point will be given when we take up the treatment of diseases.

But what is the *effective dosage*? It certainly is not "twenty minutes," as some curiously minded teachers teach. Nor is *dosage* identical with a phase of current or method, as we must infer from the most careful search for any guiding principle in the writings of others on this subject. But there is a *definite principle* governing the regulation of dosage in every form of treatment with every physical agent of the *materia medica*, including every variety of current gotten out of electricity. We have taught it for years and in our own practice it is the scientific basis of our results. Electricity without dosage is as unthinkable as drugs without dosage. Correct administration is the very heart of therapy, but it would retard this chapter to discuss it here and we shall make it plain in a brief chapter of its own immediately after the next.

CHAPTER XIII

FURTHER MODIFICATIONS OF HIGH FREQUENCY CURRENTS

Special Instructions Continued. The Spray and Its Dosage. Wooden Electrodes. Spark Intensities. An Escharotic Dosage and Technic. Thermo-Faradic and Related High Frequency Currents. Wave Currents. The Ozone Discharge. Special Ozone Appliances for High Frequency Apparatus. High Frequency Cataphoresis. Remarks. Nature's Storehouse of Tools.

THE next variety of discharge, and after the Geissler tube the most familiar, is the high frequency *spray*. It is a luminous discharge of electrified particles of flying air, best seen in the dark, and for an efficient dosage requires high voltage current. The French call it "effleuve" which is variable in translation and is a word that should have no place in the writings of an American author. The static "breeze" is more nearly an "effleuve" but the visible "spray" is of the same nature in both currents.

The spray is the creature of resistances and technique controlled by the operator. All its "qualities" and all its "actions" upon the tissues depend upon how the operator *makes* it act by his direction of dosage and administration. As a discharge in open circuit from a single pole it lacks the attracting force of the opposite pole and has but a superficial energy. Rarely is such a use called for by any diagnostic indication.

In efficient usage the patient is connected with the opposite pole, which is grounded the same as in static-machine technics. This attracts into the body of the patient a general electrification which enhances by constitutional effects the local actions directly set up on and near the surface by the spray.

The spray may be made a steady discharge or can be



PLATE X.—Illustrating an "Interrupted Spray" localized through the tissues of the abdomen. The patient is saturated with a high frequency charge as he holds the electrode connecting him with the apparatus. The attracting "spray" electrode is held a few inches from the body and moved over any area that is to be thus treated. An interrupting device in the apparatus makes the current alternately discharge and re-charge the patient, and the spray therefore surges in a series of regulated "waves," as first described by the author in his original work with *interrupted charges* in 1893. Read our remarks on "wave currents" further on in this chapter.

"interrupted," the same as every other phase of electrical discharge can be interrupted by special devices for the purpose of altering quality and intensifying action. With either a constant "current," or "spark" or "spray" the alteration from steady pressure to the interrupted pressure resembles the difference between the mere pressure of a hammer on a tack and a succession of *blows* with the same hammer. The blow drives the tack in with far greater intensity. It is very easy to demonstrate the enhanced intensity of the "interrupted" spray and spark.

By regulation of current acting through the spray electrode the discharge can be extended in length from the first visible glow on the point to a thick and energizing spray five, ten, or fifteen inches in length, with medical apparatus. With giant Tesla transformers used in power such a spray can be thrown across a large room.

On the bare skin the only sensation of the spray is a cool breeze. On a skin denuded of epidermis by any lesion the ozone mingled with the flying particles of electrified air can exert its power to combine with organic substances and render them sterile by oxidation. In the case of an ulcer the antiseptic action merges into a complex healing action made up by improving the local blood supply, removing stasis and softening induration, stimulating nutritional exchanges, and re-vitalizing the nervous functions in the field of treatment.

Upon a general skin surface, no matter where in the body, we can start with a discharge that is sedative and cool, and by manipulating the electrode at altered distances from the part and by compelling the current to force its way through regulated resistances to get to the tissues, we can create the gradually rising effects of friction, to-wit:—heat and *irritation*. This action can be made to pass from the primary sedative dosage, through tonic, and stimulating doses, to any degree of irritant intensity required to meet the given indications of the case; and can easily be carried past the indications and become intolerable and would set

up an inflammatory reaction unless stopped. The quality and action of the spray is therefore exactly what the operator makes it. Every degree of it is under precise medical control and administration, and we make its actions suit the case.

Wooden Electrodes.—The conductivity of metals cannot be varied at will, yet to vary the intensity, quality, volume and action of spray discharges throughout the wide range of this versatile means of treatment we must employ electrodes with an easily altered resistance. The convenient, flexible and satisfactory adjustment of dosage is obtained by combining an alterable conductor with an absorbent resistance, to-wit: water and wood.

Electrodes of dry wood have been feebly used for 150 years and are part of the routine equipment of static machines, and as supplied by makers are nearly useless. Some physicians cut green twigs, use them while moist with sap and discard them when dry. But a much better method was originated by the author a dozen or more years ago and is as follows:

Take a dozen round sticks of a medium soft wood such as spruce or yellow pine or the white wood "doweling rods" sold for about a cent each in hardware stores. Have them different sizes, from less than a half-inch up to an inch in diameter. Cut them in twenty-inch lengths, whittle one end of each stick to a point—some more pointed and some more blunt for variety—smooth them with sandpaper, insert a small metal screw-eye into each stick a foot from the tip to make connection with the conducting cord, and this invaluable set of electrodes is complete.

The *quantity* of current each can conduct is proportioned to its diameter and degree of dampness. The *quality* of the discharge increases in intensity with the increase in dampness and from a soft spray will merge into fine needle sparks and into still coarser sparks as the amount of water left in the meshes of the wood raises its conductivity more and more nearly to that of metal.

Therefore, with a dozen such electrodes (which will last a lifetime) we can dampen them daily, or at will, just moistening some, wetting others more freely, and soaking the rest. Lay them on our electrode stand and as they gradually dry out in the atmosphere of the room we have only to feel one with the hand to judge if it is suited to yield the proper discharge for the given case, and test the one or two that feel about right and then use the one that is right.

They should be wet from the tip to a little above the screw-eye, leaving the handle portion (held by the operator) dry and non-conducting. Command of these electrodes and mastery of dosage with them explains much of our superior results with high potential sprays during the past twelve or more years. Practice enables one to use them with great skill and definite regulation of conductivity.

The next form of discharge for local treatment is the *spark*. This discharge can be altered through a wide range of intensities, according to energy of current, thickness and length of spark, and the manner of administration. To exert a tonic contraction of muscles with comfort the spark must be relatively long, thick, and single. For intenser stimulation apply the same spark more rapidly, or make the spark thinner, or interpose greater resistance, and the degree of intensity is under exact control.

To produce an inflammatory reaction with discutient effects on small surface lesions such as warts and moles, or to shrivel and contract down mucous tissues such as a hemorrhoid or enlarged tonsil, make the spark short, sharp and intense—delivering a rapid-fire fusillade for single seconds of time, accommodating them to tolerance, and practising the great art of “letting up.” The gauge of the effect is the eye of the operator which can note the instantaneous reaction and judge when it is carried far enough to meet the indications of the given case. It is the *spark-cautery*, and is developing many and valuable uses in the

hands of certain specialists. It feels on the normal skin like the jab of a red hot needle.

Upon a wart it may scarcely be felt until the application is prolonged; and the correct dosage of intensity usually removes a wart at one sitting.

As the refinements of application and dosage with this escharotic spark by means of insulated needle-point electrodes with interrupting handle and the personal technique of the operator, place it so far aside from tonic muscle-contracting sparks, and alterative, stimulating, or counter-irritant sparks, we shall make it better known by citing its work at some length. The remarkable interest and importance of the facts justify the space for the actions are unique and cannot be duplicated.

“The density of current-dosage required to cause the discharge to act upon small growths, mucous membrane hyperplasias and morbid cells of lowered vitality, with the intensely concentrated energy necessary to devitalize, shrivel and destroy them, is obtained by using a relatively large current through a needle-point contact. All who have employed galvanic puncture will grasp the principles of it. But the high frequency escharotic action is more rapid than electrolysis in any dosage, is differently efficient, and affects a much wider area of tissue around the electrode. And while it destroys morbid cells it stimulates healthy cells. By means of a spring interrupter in the electrode and by cutting down the energy the dosage can be ranged from scarcely perceptible delicacy up to the largest amount of cauterization indicated in any case.

“In some conditions treated by this spark it is painless. In other conditions the tissues are more sensitive but the exceeding shortness of the application—seconds and fractions of seconds—renders treatment entirely tolerable. When a larger lesion is to be attacked and the region is sensitive, a local anæsthetic is used and treatment is done a little at a time and divided into a sufficient number of sittings at proper intervals so that the patient's comfort and satisfaction are maintained. Healing is physiological and terminates with practically a normal skin. It leaves either

no scar at all, or, when the action has covered an extensive area it may leave a trace of its work which is scarcely noticeable.

" Its value during four years of practice has been demonstrated in all conditions of *hyperplasia of tissue* which can be reached for treatment. Its effects are as positive as the knife, are under conservative control, produce none of the wounds and scars of the knife, and are as permanent. Under the application of the current the operator can see morbid growths of considerable size shriveled and devitalized at one sitting. The maturity of the process started by the almost instantaneous treatment may take several days, or one or two weeks, according to the nature of the lesion and amount of escharotic action set up.

" This method fully replaces the actual cautery and produces better and quicker results without accompanying inflammation. For use in the nose and throat and in cavities the body of the electrode is insulated leaving only the active end exposed. In practice adjust the exciting current to the dosage suggested by experience to accomplish the action desired in the given case. Then with the patient previously made ready, introduce the electrode with the circuit open and place the point in the desired contact, press the circuit-closer in the electrode for an instantaneous discharge of the current, and release the spring the instant the patient signals discomfort. The control is absolute.

" The treatment of enlarged and morbid tonsils, a very important field for this method, is practically painless, and as thorough as it is conservative. The point of the insulated electrode can be inserted into each dilated and infected crypt in succession. After all the desired areas are thus treated there is a rapid reduction of size and the final result is all that could be obtained by a radical surgical operation. In adults its advantages are increased by the freedom from danger of hemorrhage.

" In skin diseases this high frequency method is the one of choice in the hyperplastic lesions of acne pustules, deforming rosacea of the nose, epitheliomas, etc.

" This escharotic discharge has been found to be as positively curative of hemorrhoidal tumors as any surgical procedure—and there is no ideal surgical treatment of piles. High frequency escharotization is applicable to all cases

and will appeal especially to the great army of sufferers who dread pain, object to a general anæsthetic, and fear the knife. The action of the current in hemorrhoids is very little painful and is not followed by much pain during the healing process. These features mark it as superior to both slower applications of mild high frequency discharges and to injections and operative measures.

"In the electro-cautery the instrument is heated. In this escharotic action the electrode is cold and the heat created by the current is generated in the cells of the tissues, penetrating and spreading where the action is desired with none of the searing surface effect of the hot cautery knife. Destruction of hyperplastic cells and the stimulation of absorption and healing are proportionate to the intensity of current and duration of the flow."

From this intensely interesting and important technic we turn again to the general forms of high frequency currents and will now rapidly complete the list in medical use.

A low voltage current of around 10,000 volts, with a relatively low frequency of around 200,000, supplies us with another variation for treatment by the methods and electrodes employed in galvanic and faradic applications. It exerts the deep, powerful, and comfortable contractive influence on muscle-fibres familiar to us in sinusoidal currents, and with its quantity of considerable volume it sets up a sense of heat in the tissues which has led some users to call it a "thermo-faradic" current, a name which also suggests its place in treatment of selected conditions calling for its actions.

At the present date so many physicians are commencing their medical uses of electricity with high frequency apparatus and without previous training in the older currents that we may be allowed to say that in a little treatise on elements of correct technique (1900) the present writer gave to the profession the most compact and practical clinical instruction on older methods to be found in print. Its teachings clear up many points that should be known to the high frequency operator.

The same character of current with its frequency stepped-up to two million—a ten-fold increase—supplies a means of making a bipolar, percutaneous application of high amperage and without muscle contractions. Galvanic electrodes of large contact surface are employed and the resolvent and alterative effects of great amperage are noted. Commencing with 150 milliamperes the dosage can be gradually raised at successive sances to as high as 1500 mil., without discomfort or injury. Arthritic joints and pulmonary tuberculosis are conditions in which this partially electrolytic action is indicated.

In contra-distinction to the “thermo-faradic” current with its relatively large volume a similar current with an extremely small volume is supplied by some of the high frequency makers, for the purpose of duplicating the clinical uses of the old fashioned Leyden jar current of static machines. It is the same as respects indications and treatment and calls for no special directions here.

In addition to these medical currents a cautery current for surgical use is supplied by complete high frequency apparatus.

A large office apparatus for high frequency treatments should be provided with means of delivering all the modifications of current and dosage that pertain to this important remedy; as a well stocked pharmacy must supply its leading drugs in the various forms—solid and fluid extracts, tinctures, elixirs, infusions, alkaloids, triturates, etc., and in each of these the required strength and dosage.

Fundamentally, a current applied either to a local part or to the entire body under *continuous* pressure may have its pressure *interrupted* and be thus delivered in a succession of “waves,” following each other with any desired rapidity and with the same principles of dose required in every treatment. In all cases this “interruption” of the current may be considered as adding energy of action to the mechanical influence of the given dosage, something as any *blow* intensifies a simple pressure-force; and for this reason the inter-

rupted *general charge* and interrupted *local electrification* is a more energizing tonic, alterative, or stimulant, than the same dosage of quantity with an unbroken and steady pressure.

This is one of the differences between faradic (interrupted) currents and galvanic (constant) currents, but as relates to charges of high potential and high frequency the principle was first applied by the present author, who originated the *system* and technics in their entirety. The extent to which others have exploited this "System" under the name of "wave current" without credit to the originator will be recognized by readers of current literature who note the following facts:

The Medical Times and Register on September 9th, 1893, published an original article entitled: "A New Static Interrupted Current; A New System of Therapeutic Administration of Static Electricity Based upon the Principle of Potential Alternation. By S. H. Monell, M.D., New York."

This was the first publication describing what are now so commonly called wave currents. It dealt with the oscillatory, vibratory, characteristics and medical actions of both general and local applications, and set forth the application of the principle of an "interrupted charge" to general and local treatments. The original article was reprinted in the writer's collection of his medical journal contributions, a forty-page pamphlet entitled "Practical Chapters on Static Electricity," published early in 1895, and also, and with more extended reference, in the author's text-book of 1897, entitled, "Manual of Static Electricity in X-Ray and Therapeutic Uses."

As the title plainly shows, the "New System of Therapeutic Administration" originated by us was an entire system covering *all phases of the general and local applications of static-machine currents which utilize the insulating platform as the condenser*, as distinguished from Leyden jar discharges. There can be no other employment of an "interrupted static-machine current" or "wave current" from



PLATE XI.—An oscillatory, vibratory, rapidly interrupted, localized high frequency charge, or so-called "wave current" adapted to this apparatus from the author's system of interrupted static machine charges originated by Dr. Monell in 1893. Read remarks on this important technic in this chapter. By interrupting the current either rapidly or slowly we can greatly modify and alter the effects of both general and local electrification.

this apparatus, for it has but two "condensers"—the platform and the Leyden jars. The old system covers only Leyden jar methods; our new system originated in 1893 covers all platform methods, no matter where the spark-gap interrupts the charge on its way from prime conductor to the patient. (In saying this we exclude any interrupting electrode such as the obsolete "pistol-electrode.")

In our use of the term "potential alternation" (or alternating potential) we had reference to the rise and fall of *voltage* in the interrupted charge. We may read "oscillatory current" or "alternating current" or "wave current" instead of Alternating Potential, and some may think that our meaning would have been clearer, but we clearly taught the *principle* of the "new system of administration" and a wholly satisfying title was not easily written in 1893. The term "wave current" did not appear in connection with our methods until 1899, six or more years after we had published our original description of interrupted charges.

On pages 223-4 of our clinical treatise on correct technique in electro-therapeutics a further account of our "new system" appears, dated January 4th, 1900.

Owing to the almost universal employment of some form of "interrupted charge" by those who use high frequency currents to-day it is interesting to note that with static-machine technics there are *two* ways of regulating the dosage—two distinct paths of spark-gap interruption. My personal students in past years were taught both, and the manifest superiority of one over the other was demonstrated in my clinics. But so far as can be judged from current reports those who have adopted the system from my writings seem to only discover the less effective technic which the originator of the methods never employs in his own practice.

Hence the extremely valuable "wave currents" originated by the writer have been in recent years sent broadcast over the country shorn of their fullest merit by the defective teachings of some who have adopted our "New Static In-

errupted Current; A New System of Therapeutic Administration of Static Electricity" without the clarifying advantage of witnessing a personal demonstration of our effective methods. To makers of apparatus and to medical writers who so generally credit this system to other sources we commend a reference to our original article of September 9th, 1893.

Still further in the list of weapons furnished by this versatile appliance in a form for ready and useful administration, is *ozone* created by condensing a portion of the oxygen of the air in the path of the high potential discharge. Ozone is defined as an allotropic form of oxygen, with a density one and a half times that of oxygen. It has great power for destroying offensive odors, and is a powerful bleacher and intense oxidizer, as all who have used the familiar peroxides of hydrogen sold for antiseptic uses are aware.

To demonstrate it in a high potential spark or spray simply wet a spot on a blotter with a few drops of 10% K. I. solution and direct the charge upon the spot. The iodine is liberated and turns the white spot to a chocolate brown. Or, dip a piece of red litmus paper in the same solution of K. I., and apply the spray to the wet end. The ozone will decompose the salt and the released potassium for the alkali potash which then turns the red acid litmus to blue.

To be convinced of its passage into the body and lingering stay there one may both smell it and taste it. Also, after an application to the chest the litmus paper test will detect it in the expired air. Other demonstrations are to be found in the actions of the gas, which are typical and could only result from its presence internally. Externally, its effects are visible and unmistakable, and besides destroying the bacilli of pus it dries the secretion of mucus, or any secretion it reaches, and thus doubles its value in the treatment of ulcerative lesions. It can easily be inhaled directly from a vacuum or spray electrode held near the nose, or driven into the thorax during a vacuum electrode application to the chest. Makers also supply elaborate accessory appliances

for the generation of ozone and removing impurities, equipped for inhalations by one, two or four patients at once.

Fresh air contains a trace of ozone and at the sea shore we seem to be more conscious of its tonic exhilaration than inland. Assuming that a highly ozonized air (purified by passing it through the vapors of aromatic essential oils) should concentrate the benefits of sea breezes in a physician's office, makers supply instruments developed from this idea and which cost from \$150.00 to \$700.00. The author has had no personal experience with this rather costly attachment to high frequency currents but will cite here the published statement of what the apparatus will do.

"The vapor thus obtained from the machine is the most powerful antiseptic, germ-killing agent known. In laboratory tests it has quickly killed pathogenic germs of every description, while, when treating disease, it has done the same thing in the human body, killing even tetanus bacilli without the slightest injurious action upon the patient. Inhalation for half an hour absolutely sterilizes the blood by saturation with the ozonized vapor.

"Among the germ infections in which it has been tested and shown excellent results as a curative agent are: Syphilis, tetanus, tuberculous infections by staphylococcus, streptococcus, typhoid bacillus, pneumococcus, gonococcus.

"It is a very quick and powerful regulator of the vasomotor nervous system and as such has been found of the greatest value in neurasthenia, melancholia, hysteria, nervous impotence, nervous asthma, and other neuroses. It regulates the peristaltic action of the bowels, a single inhalation of half an hour often inducing a passage in long-standing constipation. Insomnia is quickly relieved by it, a refreshing sleep usually following inhalations when taken in the latter part of the day.

"It increases the number of red blood corpuscles, so that cases of anæmia will show a constant increase of them during treatment until the normal count is reached. It increases the oxidation of food and elimination of waste, thus being of great value in diseases that depend on improper

metabolism. During treatment the appetite usually increases and there is a gain in weight.

"The volatile oils contained in the vapor are themselves, independent of the ozone, very valuable in diseases of the respiratory organs. The condensed vapor in fluid form, in local application by an endoscope, will cure gleet in one to two applications; injected into tuberculous joints or ulcerations of bones, it will cure these. The oil in the oil containers through which the ozone has passed for some time is valuable as an antiseptic skin dressing and has shown excellent results in varicose ulcers of many years' standing. Used together with inhalations of the ozonized vapor it will cure many diseases of the skin."

Associated with the antiseptic action of a high potential discharge in the conversion of oxygen into ozone is the actinic radiation from the vacuum tube electrodes of different degrees of exhaustion. With a low vacuum these rays belong to the violet portion of the spectrum of light, while with the higher and nearly x-ray vacuum they are shorter vibrations and belong to the ultra-violet part of the spectrum.

The term, "violet rays" is often misapplied by both physicians and laymen, but a single glance at the actual solar spectrum through a good spectroscope will forever make clear the proper uses of the terms, "violet" and "ultra-violet," while a single reading of the section on the medical uses of light in our main treatise on the physical agents, will make the distinction between their effects in treatment entirely plain. There are some violet rays of light in the low vacuum tube discharge and they add something to its action, but the principal work of this instrument is done by the current and ozone.

To obtain true ultra-violet radiations from high potential currents a small spark-gap lamp is made and successfully employed in the treatment of a number of skin diseases. These rays are invisible to the eye, but their presence is demonstrated by the fluorescence they produce on a piece of Willemite rock.

One feature of minor interest in connection with treatment by means of high frequency currents, is the demonstration of our ability to drive finely soluble drugs through the skin and into the internal tissues. This action differs in quality from the familiar cataphoresis of the galvanic current, and was claimed for static-machine discharges as long ago as 1775 and then forgotten.

Some have made a great deal of use of this action in the treatment of consumption and rheumatism, and we find reports of its application in gynecology, but it appeals mainly to men saturated with the traditions of drugs and novices in their knowledge of electricity. The action of properly administered electric-currents so far out-reaches and surpasses the effect of (high frequency) cataphoric medication under the conditions of practice that no really competent judge can attach much importance to it. Still, if the method has any value it can be employed. It is simple enough.

This greatly compressed and far from complete story of the medical resources of a fine high frequency apparatus must have added to it the splendid chapters of hydrotherapy, of light-therapy, of vibration, and heat, before the reader can comprehend the magnitude of the term, "physical remedies," and form the crudest idea of their place in the modern materia medica.

He who reads reports of results of treatment with "physical agents" with no mental picture before him of the full storehouse of tools they represent feels it his duty to be incredulous. He fancies to himself a single tool and denies to any one agent the ability to do so much work. He instinctively compares the physical remedy with a drug—a single drug—and says, "no drug can cover so much ground."

But the action of the physical remedies is as wide as physiology. The variety of measures they bring to the co-operation of medicine and surgery is very much greater than all the tools and resources of surgical art, and the inventive genius of mechanics lends accuracy to administration. They do not antidote disease or the toxins of disease, or chemically

neutralize poisons in the body. In thinking of them the whole picture of drug prescribing must be laid aside and our eye fixed on the curative processes of *Nature* in animals and man.

The drug-trained physician and the educated layman call up to mind a list of diseases columns long and drugs to the number of fifteen hundred which fail to cure them all, but mankind is not afflicted with 500, nor 300, nor 100, nor 50 different *disease processes*. Under normal conditions health is the proper working of a few physiological functions; mainly a half dozen. These are each liable to a change which disturbs the rate of regular action. A physiological process may thus be increased in activity, or diminished, or temporarily stopped. If the rate of change from normal is very marked the resulting disturbance is called "disease"; and different causes, even germ diseases, poisons, and injuries produce their results by their effects on these same processes of nature.

Nature tends to "cure" all really "curable" diseases herself and admittedly succeeds in a great many cases. She has no drug store at her command with a thousand antidotes—she has simply her strong inherent effort to restore the normal rate of the deranged functional processes, and if she succeeds the state of health is resumed no matter what one of fifty names the "disease" may have been called. And here we strike the key-note of the medical resources of physiologic remedies, the chief of which is electricity.

Those of us who sought to give our patients the benefits of all approved remedies and adopted electricity in our medical practice in the earlier days when physicians had only a crude faradic battery, or an incomplete and unsatisfactory galvanic battery, or a small and still more unsatisfactory static machine, to cover the then resources of electro-therapy, may look around at our modern equipment with something of the gratification of pioneers. To have lived through the development from embryonic "faradism" to high frequency, and the now splendid instruments for the

application of physical agents in medicine, and to have been a part of this great advance and a participator in the development, is to feel a recompense in the fruits of our missionary labors which no new comer entering the ripened field can share. Men who witness only the harvest, and those who plowed and planted for that harvest, view it from two different standpoints.

Certain minds yearly since the great physiological demonstrations of Duchenne, pride themselves upon their "scepticism" as regards electricity in medicine, but no physician who has worked with it in practice and has acquired an expert knowledge of its properties and uses and the means of meeting indications with its actions, ever fails to grow in admiration and profound respect for one of the noblest healing agents vouchsafed to medical art. Ignorance of it can speak according to the ways of ignorance, but never can the time-taught veteran of a thousand experiments and of hundreds of hours spent in practical research into its many-sided actions, overstate his appreciation of its value to his patients.

Take electricity from the *materia medica* to-day and no other remedies exist that could fill the gap. Give to electricity its rightful recognition in medicine and *universal use in its proper place*, and the suffering of the world would be cut in half. The time will come when the withholding of the resources of the great physical remedies from patients who need them will be regarded in the same light as the withholding of water from a case of fever, or food from a consumptive.

CHAPTER XIV

PRINCIPLES GOVERNING ADMINISTRATION AND DOSAGE IN HIGH FREQUENCY TREATMENT

Cause and Effect. Selection and Use of Electrode. Importance of Localization in Local Treatments. Regulation of the Intensity-Dose of Current. Duration of Treatments. Directions for Posturing Muscle-Fibres to Obtain Effects. The Factor of Regulated Resistances. Pressure. Rules for Frequency of Treatment.

THE fundamental principle in the use of a remedy is to first see what work you want to make it *do*. If you want to get the effect of velvet don't rub the tissues with a piece of sandpaper. If you want to get the effect of a definite stimulant don't offer the tissues the pretense of it. If you want a general tranquilizing sedation of the nervous system don't treat the patient with an irritant spray. And when you want actual destruction of tissue for the removal of a small growth don't coax it gently with a glass vacuum electrode but attack it with an escharotic spark. These are the guiding principles that bring results in the applications of high frequency currents of electricity.

The next thing after selecting the character of discharge that will furnish the effective intensity of action, is to administer it through the medium of an electrode that will conduct the remedy to the tissues in the effective way, for the word "electrode" means simply "the way."

The third point in treatment is to manage the use of the electrode so that it becomes the *way* that will rightly direct the current to perform the required work of treatment. A mere perfunctory holding of an electrode without making it the means of enforcing action is useless. If you wish to brush your hair you do not merely rest the brush on your head; nor do you select a nail brush for a hair brush. The

same principle applies to the selection and directing management of an electrode.

The next point in local treatment is to aim at the right place in trying to set up the necessary local action, for almost the whole demand for technical exactness springs from the necessity of securing local effects in local diseases or on localized symptoms. In nailing a cover on a box it is a waste of time and nails to drive them inside the edge where they take no hold. Unless directed through the cover into the rim the cover is not nailed on to stay, no matter how good the nails, or the hammer, or the box. It is a case of directing the work to secure the right effect. All physical remedies are subject to the same rule.

When a physician writes a drug prescription his control over its destiny ceases with the act of handing it to his patient. The patient may take the medicine, or he may not. In many cases he either omits this ceremony altogether, or is not regular in the function; but if he takes the medicine he also loses further control over its destiny and performance when he swallows it. From that moment the results, be they what they may, arise from properties inherent in the dose, and the actions are not affected by any skill of physician or attitude of patient. A dose of quinine is a dose of quinine, and it acts as it will, not as we make it act. We cannot direct, alter or control its destiny in the tissues.

On the other hand, an apparatus supplying the complete resources of high frequency currents of medical electricity must be considered as a box of tools from which we select the one best suited to the class of work we wish to make it perform, then take it in hand and make it do what we want to make it do. It is an instrument of precision, under definite direction and control, and has no power to act for itself in meeting the indications of treatment. A hammer cannot drive a nail itself. A saw cannot saw a plank itself. A gimlet cannot bore a hole itself.

Saw, hammer and gimlet are "physical agents" of the

carpenter, and whatever they accomplish in the building of a device is the result of how the carpenter uses them, and the materials he uses them on. Their field of action is not brick, stone, steel, or the very hard woods. Applied to soft woods they can be made to do useful and effective work.

Electric currents are physical agents for the physician. What one of them will accomplish for him in his medical practice depends on the tissues which are his materials to alter and amend, and on the way he applies his varied electrical tools to produce the repairs needed. We have been reiterating this fact for fifteen years but thousands of physicians forget it and it seems impossible to make it too plain.

The next thing to consider in seeking to produce a local action of a desired kind is regulation of the intensity of dose, for in electricity as in drugs, the amount of acting-energy in the given dose is all-important and never to be left to chance. Failure to dose the intensity of action is a continual source of disappointment in the non-scientific administration of any current.

Next, do not time treatment by minutes but by effects. A cook book may direct the baking of a cake in minutes, but even a cook will try her cake to see if it is done before she takes it out. Much more should the educated physician determine the length of treatment by the attainment of its object. With a desired effect in mind as the purpose of a given application, the time required will vary with the intensity of dosage and responsiveness of the tissues; hence the physician must be competent to judge whether the effect he seeks is possible in the state of the tissues, and if the remedy he employs can be made to set up the actions necessary to produce this effect.

Sometimes an effect can be completely obtained and sometimes only obtained in part, or developed gradually as the result of a series of treatments. In these different circumstances we must know when we have produced all the benefit possible at the given treatment and then stop until

the next application. Otherwise the unregulated persistence of action might work injury in some cases, or produce results not intended by the prescription.

Another very important matter in the treatment of many conditions, especially those associated with muscular pains, or painful states which are aggravated by muscular movements, relates to *posturing* the tissues so that the action of the current can be made really curative. The author taught this special feature of treatment to his students for many years but finds no mention of it or the principle involved in the writings of any other physicians.

If we have a case of muscular rheumatism of the shoulder the arm may be entirely comfortable when by the side at rest. To apply an electric current with the arm in the position of comfort is not treatment of the condition that asks for relief. The muscle fibres being already comfortable in this position we should not expect to add anything to their comfort.

But if it hurts to lift the arm to the head and stretch it backward or make other motions, then have the patient posture the arm in the position that sets up the worst pain and make your treatment act upon the fibres in the *relation of discomfort*, and when the necessary action has given relief comfort will take the place of the former pain and the benefit will be genuine and lasting. Follow the treatment through every movement that can be made to cause pain.

The author's principle of *posturing* in muscular conditions is well illustrated in the treatment of lumbago, one of the simplest myalgias to abolish but of which many physicians make hard work, or partial or complete failures. To recline a patient with lumbago on a comfortable couch and promenade an electrode over the lumbar muscles, which, in this position, are in a relation of comfort, usually misses the mark and subjects the remedy to fault-finding when the party at fault is the person using it.

But sit the patient on a stool, have him bend forward and

strain the muscle fibres into the relation of pain, and then apply treatment with an efficient dosage, and the result will astonish the very man who used it without success before. Follow up the posturing through all the necessary positions, having the patient strain in rising from the stool, etc., and at each aggravation of pain attack the fibres and do not stop until all positions and movements can be assumed without any pain at all.

The same principle applies to sciatica and often controls the success of treatment. No efficacy of current or skill in mere management of electrode can offset neglect to posture the muscle-fibres when movements or positions cause discomfort or excite pain or aggravate it. These posturings are illustrated in several of our Instruction Plates.

Still another help in producing results and one we have exclusively taught our students is the control and regulation of *dry resistances* in local treatments with forms of discharges which are affected and modified by a resistance in their pathway to the tissues. The great examples are, the brush discharge (spray) and fine needle-sparks, applied either from metallic points or glass vacuum electrodes. The importance of this factor in dosage requires us to make it very plain.

When a person glides over smooth ice there is very little friction. You may scuffl. over an ordinary floor and not develop enough friction to liberate any visible phenomena of electricity. When a floor is covered with a thick woolen carpet we may scuffle over it and produce a small frictional charge in our body which is discharged as a spark on holding a knuckle to the gas fixture (which is a grounded conductor). In the old "frictional electric machines" of the eighteenth century dry fur or silk was rubbed on lacquered glass plates to create the required amount of friction to generate small spark discharges.

Thus, friction is a means of liberating electrical energy converted from mechanical energy. Friction also produces heat. We warm our hands by rubbing them when cold.



PLATE XII.—Illustrating the author's method of posturing the muscle fibres in a case of muscular rheumatism of the shoulder or neck. Strain the parts into a painful position and apply the proper counter-irritant dosage through a dry resistance cloth (if necessary) or through sufficient clothing, until pain is relieved. Treat in all the postures that produce pain, until freedom of movement with comfort is fully restored. This principle of "posturing" runs through the treatment of all painful muscular conditions and is of great importance. It has not been taught by any other writer but is often the essential difference between success and failure in treatment. See page 247.

The diagrams illustrate the arrangement of particles in three states of matter:

- Solid:** Particles are arranged in a regular, repeating pattern, representing a crystalline structure.
- Liquid:** Particles are arranged in a disordered, irregular pattern, representing a liquid state.
- Gas:** Particles are arranged in a highly disordered, irregular pattern, representing a gaseous state.

If a person should slide down a rope very fast the friction developed would be intense and would blister the skin. Therefore, according to degree, friction can comfort or blister the hands. The principle is the same in regulating the dosage of an electric current.

The wet skin lets an electric current slip through it as smoothly as feet slip on ice, but a dry skin is some resistance, and dry hair is a great resistance to an electric current, and on the epidermis a little friction is created if much effort is required for the current to get through. With a high voltage current no appreciable effort is required, hence there is no friction and a wet electrode or a metallic electrode in contact with the skin sets up no heat or effect of friction.

But if we make the current force its way through some resisting fabric en route to the skin the non-conductor causes friction in proportion to the work performed by the current in the passage. Fabric and thickness govern the degree of friction. Cotton goods let the current through easily, silk almost as easily, while kinky-fibred wool is thicker and more resisting.

The effects of interposing a single non-conducting layer of cloth between the cuticle and the electrode are to the skin as the effects of friction. Instead of a neutral contact where the current enters the sensation is now one of stimulating warmth to the nerve endings. With each additional layer of cloth the frictional effects increase, up to a point of resistance which nullifies the effort of the current to get through it.

The sensory effect can thus be made to attain any degree of stimulation desired, and all shadings of irritant action are secured at will. Control of dosage is as complete as our power to regulate it, and a review of the medical importance of counter-irritation makes clear the value of this means of acting upon the sensory reflexes of the body.

The applications of this principle to treatment are many. All conditions requiring sedation should avoid interposed

resistances and the electrode must be applied to the bare skin or with only thin and conducting coverings on it.

Conditions requiring a stimulus rather than a sedative should be treated with the epidermis dried with toilet powder (which adds materially to its resistance) or some thin layer of cloth to create enough friction to act with the stimulation needed. In these minor degrees of intensity we gain part of the dosage by increasing the amount of current delivered through the electrode. In higher degrees of "irritant" intensity we secure the effect by regulating the exact resistance we require to set up the action needed by the given state of the tissues.

When glass vacuum electrodes are rubbed on a powdered surface of the skin the powder coats the glass bulb and after each treatment it must be washed off to make the electrode ready for the next patient. Another factor in dosage is *pressure*, which we will next consider.

Just as we govern our pressure upon a key to unlock a door, so we govern our pressure upon an electrode to accomplish the effect we wish. At the stationary electrode the one rule of firm contact applies to all cases but the active electrode which the operator directs with his hand needs judicious regulation of pressure in different cases.

Pressure upon an electrode during treatment has two qualities—steadiness and weight. An uneven pressure will either affect the results or disturb the comfort of the patient. Too light pressure alters the degree and depth of action with currents which are convective and not disruptive discharges. Pressure that is too heavy will annoy the patient or the local tissues and tend to impair the good result.

Regulation of pressure upon the electrode is particularly important about the head and spine, in treating painful conditions marked by tenderness, and in ensuring depth of action. With a little practice it will be intuitively directed to the needs of the case. For instance, to soothe an aching temple the sensitive tissues would resent a hard pressure



PLATE XIII.—Illustrating the author's "Deep Pressure" method in the treatment of neuralgic pain, or congestion, or irritation and tenderness, of an ovary, or any organ or tissues within the pelvis or abdomen when only external applications are admissible. Have the knees drawn up to relax the abdominal muscles, request the patient to exhale forcibly and retract the abdomen as much as possible. Press the tip of the electrode deeply down into close relation to the affected tissues and treat as needed to meet the indications. Many times deep pressure will succeed when a mere surface application of the same current will fail.

and enjoy the gentle touch of a delicately stroking hand. A thumping tooth that is relieved by pressure will be best treated by hard pressure of the electrode. The firm wall of the chest over the ribs calls for an even and close contact of the electrode without more than enough pressure to produce it. Heaviness of the hand or electrode upon the chest is not comfortable as a rule, and moderate pressures are indicated.

But an ovary is deeply situated in the pelvic cavity with soft and yielding tissues fronting it. A surface contact of the electrode in external treatment to relieve ovarian pain will not be apt to reach the buried organ with the message of rest and calm. Therefore have the patient draw in the abdomen and press the tip of the electrode deeply down to the ovary and get the current to it. This is the principle of *pressure* in high frequency treatment.

The principle governing *frequency of treatment* is simple. A patient should be treated as often as is needful to secure the greatest and most rapid benefit. In practice circumstances often interfere with the complete application of this ideal.

In acute diseases if the object is the relief of pain and suffering the application should be made as often as is required to keep the patient comfortable. If the same patient merely needs upbuilding when he is past the period of suffering a tonic administration may be made night and morning.

In office practice and in the treatment mainly of chronic diseases the rule varies according to the effects that can be produced by the current. If these are quickly obtained, last but a number of hours, and then lose most of their temporary relief, treatment should be daily until the benefit lasts longer. As improvement increases the applications can be made every second day, and later extended to but twice a week till recovery makes them unnecessary.

In certain diseases of slow progress and slow response of the tissues to a healing stimulus we must permit nature

time to work out her response to one treatment before we administer another. So that in these cases two treatments a week may be the wisest frequency, gradually varied according to the results produced. We may see reason to make them oftener, or at still longer intervals. In certain intense reactions, as from an escharotic spark, we let nature mature the reaction from one treatment. This may take a week or more, or somewhat less. Judgment works out the matter of frequency after a little experience.

Many other rudimentary points are so familiar to the majority of physicians who use electric currents and who have our larger and general treatises on electro-therapy, that it is unnecessary to attempt to crowd so small a book as this with repetitions of ordinary matter. Also, owing to the diversity of equipment in the hands of different physicians each reader, already familiar with his own apparatus, will wish to be spared a mass of details that relate to others and do not interest him.

We therefore bring this section to a close and turn to the consideration of *treatment*, a subject of the greatest interest to every one.

PART IV
The Consideration of
Certain Diseases
and
Their External Treatment
by Means of
High Frequency Currents of Electricity

CHAPTER XV

PREVENTIVE MEDICINE

The Personal Application of Medical Wisdom. Nuggets of Advice.
The Simple Rule of Health. Directions for Preventing Preventable
Sickness. Technique of Treatment.

WE have now arrived at the section of this book which concerns specifically the aim and end of the healing art—the treatment of disease. But modern medicine seeks to prolong life and uplift the economic value of man to himself by repelling certain *beginnings* of illness which none of us should permit to enter our houses. Yet the extent to which we fail to stop the cracks by which disease enters (as we stop cracks to keep out the winter wind) is startling when figures are bunched for us by an authority. In a recent lecture, Prof. J. W. Jenks, of Cornell University, said:

“In our country minor ailments which do not result in the calling of a physician cost an economic loss of not less than *250 million dollars* per year, and by proper care nine-tenths of this loss could be saved.

“The loss that comes from over-fatigue or a lowering of one’s vitality or power of endurance, is even greater probably than that due to illness, from the economic point of view. This impairment of health, coming too often from the use of alcohol or of tobacco, or from abuses in diet, or unnecessary loss of sleep or undue length of the working day, amounts probably to very much more than the direct loss from primary disease.”

So that before we take up the treatment of specified sickness we should consider the bearing of preventive medicine on the lowered states that precede it.

Much observation of young people, especially of young

parents and their almost murderous methods in defiance of physiology, must convince any competent mind that some judicious *first aid to common sense* in the curriculum of our schools would prevent a lot of actual race-suicide that now goes by another name. The cruelties of motherly ignorance and the self-inflicted sufferings of adult imperviousness to rational care of health often produce results as barbarous as the horrifying tortures of Apaches—all the more regrettable because so utterly unnecessary. We therefore invite attention to this chapter and the next, as far more worthy of an aroused thought than the brevity of their pages may indicate.

Of late years we have heard much about "Preventive Medicine." To some it seems to be the supreme mission of medical science, for an ounce of prevention is held to be better than cure—unless one is sick.

But what is *preventive* medicine? It is not a remote idyllic dream, nor altogether an abstruse problem in the higher mathematics of sanitation that nobody can understand but the Health Board. It is practical common sense. It begins right at home. Every breath of fresh air and every good square meal properly eaten is preventive medicine. So is a pair of dry stockings when the feet are wet. But in the eye of the physician the state of immunity from disease which "preventive medicine" aims at for the individual, resides in a *normal resistance of the tissues*. The key to keeping well (and hence not getting sick) is to maintain a high *tissue-resistance* against bacterial infection. This is largely a matter of the physiologic functions of the body.

Now, if the reader will turn again to our earlier chapters on life phenomena and the physiologic influence exerted on them by high frequency currents of electricity it will appear very plain that when some obscure internal impediment prevents the natural processes of the body from fully profiting the individual by what he eats, drinks, breathes, wears, and otherwise does in pursuit of health the decisive measure to apply to remove the impediment and to give nature her head

is often electricity. Those who can read the facts and still hesitate had better read them *again*.

So many times American attention has been drawn to the alleged custom of retaining Chinese doctors on a health-preserving salary which stops if the client gets sick that the papers stir us up on this subject. A large treatise on Preventive Medicine was published two or three years ago, and a rash maker of a semi-food-medicine offered cash prizes for essays (which should not mention his product) and we have his personal writing that it cost him \$15,000.00.

So, obviously, this is an important subject from all standpoints. We think it possible to put the *gist* of it in a few words. Practice intelligent discretion and common sense in the habits of daily life and always keep up to *par*. But if the system falls below *par* promptly restore its normal energies by the aid of high frequency currents. Lastly, if disease approaches, threatens attack, or makes an assault whether fierce or feeble, seek treatment *at once*.

Herein lies more logic of preventive medicine than may be found in archives of Chinese learning or libraries of the literature of fads. Avoid fads if you want to keep well. But don't delay rational treatment if you prefer not to get sick. A mere net-work screen can keep a man from falling out of a skyscraper window but after he passes the tenth story on his way down to the side-walk it is hard to stop him. High frequency methods of treatment are as follows:

Tonic Treatment to Maintain High Tissue-Resistance.—If *par* is pretty nearly present a few administrations of high frequency auto-condensation treatment will usually close up the breach in the energies and stop at the onset the tendency to "run down."

For more vigorous "prevention" when the process of "running down" has made some greater progress treat as follows:

Apply a vigorous tonic dosage of high frequency current to the nerve centres of the spine with the ordinary glass vacuum electrode and the opposite electrode over the solar

plexus. Reverse the patient and apply the same to the region of the stomach and entire intestinal tract and liver. Finish with stimulation over the chest and a few inhalations of ozone from the tip of the vacuum electrode.

Repeat according to the state of the patient, the extent of depression present; the anæmia, cachexia, or other impairments to be removed. Also prescribe any internal medication that will add to the benefit.

CHAPTER XVI

THE QUICK-REST TONIC IN THE FATIGUES OF HEALTH

High Frequency Currents as the Quick-Rest Tonic for the Weary. The Tonic-in-Chief for Active Business Men. For the Fatigues and Fidgets of Desk Workers. For Brain Workers with Brain Fag. For the Strain of Great Responsibilities. For Legal and Other Professional Experts. For Writers, Lecturers, Editors and Teachers. For Stock Brokers and their Clients. For Devotees of Society, Music and the Drama. The Prime Tonic After Dinner. The Swift Substitution of a Clear Head for the Dulness of Clogged Brain Cells.

FOR still another moment let us refrain from sickness and regard simply tired health and states of every-day fatigue, for so great a tonic as electricity does not restrict its usefulness to the hospital and the sick-room, or require an invalid for its application.

In opening this therapeutic section by antedating disease and seeking to avoid it we simply recognize the trend of up-to-date medical thought in respect to sound advice. Vaccination is not the only prophylaxis—we have even prophylactic tooth brushes. But electricity is the greatest “preventive medicine” in the world, as our chapters on physiology amply show.

The “refreshing” effect of a high frequency current on the tired body has spread its repute as a quick-rest tonic wherever it has been used. Said a gentleman recently—a gentleman of solid proportions and dignified age—“As the result of using it lately I feel like throwing out my chest, expanding my lungs, and taking a deep breath. I feel buoyant, exhilarated, and like running and jumping.” And here we have the keynote to the tonic action of this agent and *its power to neutralize fatigue.*

In practice we often hear a patient voluntarily remark

after treatment: "I feel now as if I had just had a nap, taken a bath and put on a new suit of clothes." The reason of this restful and refreshing action we may find on turning to our chapter on condensed physiology and reading as follows:

"The products of tissue-waste during work first affect the nerve centres and diminish their power to send out further impulses. The seat of fatigue is not to any extent in the muscles, and nerve fibres are unfatiguable, but *the central brain cells* are very sensitive to the toxins of destructive metabolism. The chief waste products of work are carbonic acid and sarco-lactic acid, and an atmosphere laden with an excess of carbonic acid will stupefy any tissues that breathe it, as the same gas suffocates its victims in a mine. What we call fatigue is in reality nature's notice to us that there is an over-accumulation of carbon dioxide and other toxins in the nerve centres, making them dull with the heaviness of a narcotic. The remedy is to drive out the toxins and refresh the cells with fresh air and oxygen."

Fatigue may be artificially induced in a muscle by feeding it on a weak solution of lactic acid, and then removed by washing the acid out with a mild alkaline salt solution. If the blood of a fatigued animal is introduced into the circulation of a resting animal the latter will develop all the symptoms of fatigue without doing any work at all. The *toxins* produce centrally the sense of weariness.

Waller, the great investigator of nerves, found that the effect of carbonic acid on a nerve is to cause a diminution and finally the disappearance of the galvanometric response, but when this gas is replaced by air the nerve recovers and the action-currents increase. The researches of Baeyer and Fröhlich have recently confirmed Waller and they have shown that peripheral nerves participate in respiratory exchanges. In the absence of oxygen, stimulation ceases to evoke the activity of a nerve, but on re-admission of the gas the recovery of the nerve is *almost instantaneous*.¹

¹ These facts are cited from Kirkes' "Handbook of Physiology."

From this knowledge to the application of it is a short step for electricity, but for unaided nature or the ministry of drugs it is much longer. Sleep knits up the ravel'd sleeve of care and is nature's sweet restorer, but there are times when it is hard to get when most needed, and it can neither be forced nor condensed at will. As to drugs, we know of no medical prescription that antidotes fatigue.

As a mere demonstration of the power of a high potential current to create the full sense of physiological rest we have taken a desk-worker at the limit of endurance, so fatigued and fidgety that he could no longer push upon his brain, applied a swift stimulus to the back of his head and upper spine, and in less than the lapse of three minutes he has been restored to condition for renewed and competent effort.

We have taken men on the verge of acute break-down from days of strain and anxiety in business and in a single and short treatment with a high frequency current have enabled them to face the crisis and fight back their fears. We have seen electricity put buoyancy into the steps of men sinking under cares of sleepless anxiety at home and high-pressure labor at their office. We have seen it take the drawn look from the face and the heaviness from the heart of women worn to the very edge of exhaustion. We have seen it release the tired teacher from the jaded mind of her routine, the tired scholar from the useless over-tax of examinations, the lecturer from the results of combining an editor's toil with his tasks of speaking, men attempting to double their salary by ending the day with eight hours duty at night and all these and many others we have rescued and rested and given new vigor for their work.

There is a marked difference between the fatigue-effects of a brief period of over-work or strain and the effects of a slowly acquired worn-out state, and this difference must be taken into account in treatment. There is also a difference in the restorative needs of the person who is stiff and lame from extreme and unusual muscular exertion, and the needs of the brain cells that have been sleepless and irritable from

excitement, worry, or mental tax. And we meet also a third class of fatigue resulting from mental and physical exhaustion combined. For all these states there may be other means of restoration (though for some of them time is not a cure) but the one *swift and decisive tonic* and quick means of rest is an electric current.

Treatment.—For acute nervous tire from excessive brain work and diminished rest or sleep, apply the high frequency current through a glass vacuum electrode to the cervical spine and back of head, using a tonic dose sufficient to create a sense of comfort and moderate warmth under the electrode. After five minutes on each situation move the electrode to the forehead and apply the same current reduced to suit this more sensitive region.

Two minutes inhalation of ozone from the tip of the electrode will add a still further stimulus.

In a severe case the eliminating action of an electric light bath (properly given) just previous to the high frequency treatment will increase the benefit. The single treatment will provide more restorative rest than nature could supply in twelve hours sleep, but to provide the fundamental basis of work there are no lasting substitutes for sleep and food, so that however wonderful an emergency rest-tonic may be in its aid to nature we cannot maintain health continuously if "tonics" are long used as *substitutes* for rest instead of in their rightful place as *aids*.

If the condition of fatigue has been of long duration and the person still works beyond the power of his unaided tissues to eliminate depressing *toxins* as fast as they are produced, the same treatment should be repeated daily for a week, and then two or three times a week until the normal energy is restored.

If the muscles of the body, or any part of the body, have been subjected to excessive work, and particularly if lame or stiff, precede the above treatment by going over the muscles with a refreshing tonic current (the current of relatively low potential and frequency) applied through sponge

covered electrodes. The sense of lightness and buoyancy that can be imparted to heavy muscles must be felt to be appreciated. Then treat the brain and spinal centres as directed.

In the treatment of any form of fatigue from any cause we have but one principle to apply: First apply the electrical stimulus to the centers of the brain and spinal cord to eliminate the depressing toxins and restore the refreshing atmosphere of oxygen in which alone living tissues can feel animated and bright; and then revive and refresh the nerve-endings in the tissues which manifest the localized sense of fatigue by applying to them an electrical stimulus to restore their lost tone.

One of the temporary effects of a hearty dinner is often a sense of mental dulness, or even acute drowsiness and heaviness, which is inconvenient to one who desires the use of his brain, or at least desires comfort rather than a premature craving for bed. If the room is over-warm and wine has been a very liberal part of the banquet this sense of heaviness can affect the eyelids like a narcotic—which, in fact, it actually expresses, for no opiate is more stupefying than retained CO_2 in excess of normal.

To sleep it off takes time at a most inconvenient season, but to get a clear head quick and be ready for any engagement or business that may wait, simply take up a glass vacuum electrode, throw through it a tonic dose of high frequency current, and inhale the ozone discharge till the lids lighten and the brain cells feel invigorated. This can be supplemented by making a short application of the electrical stimulus to the region of the stomach, behind which is the "abdominal brain" and the ganglia of the solar plexus.

This useful, safe and efficient tonic can be made of great service to such devotees of society as have more demands on their time than due regard for health should permit them to meet. But the daily aid of this vitalizing energy of nature will go far to keep up the rosy bloom of a refreshed complexion and long delay the wan and haggard paleness

and rings under the eyes which turn once winsome beauty into something we feel sorry for. No woman who is worn out looks attractive. High frequency currents can help all such immensely.

Just a word now about that whirlpool of stress and kicked-in-the-stomach feeling—Wall Street. Also its brokers and their clients who hover between the nerve-wracking agitations of suspense, panic and despair.

There is no foe to the liver like suspense. When the liver fails the game is up. No man can play stocks with a clogged liver. To attempt to do so spells disaster. And to illustrate the relation of liver to life in Wall Street let us cite a typical experience among many.

A trader, having been instructed by malevolent fortune that something was wrong with his judgment, consulted his physician. When his liver was in rebellion he saw only blue gloom and ruin facing him. Suspense and worry reacted again on the functions of his liver and inhibited its regulators and deranged its cells. This might happen from some indiscretion in a perfectly calm market but the effect on him was that of a panic. It was always so.

With his liver and brain centres treated to an eliminating and refreshing electrical tonic the skies cleared, the same circumstances appeared bright, and with no alteration whatever in his contracts he would return to the floor as hopefully as he had previously been despondent. The moral of this has many applications. If a word to the wise is sufficient we may now turn to the business of making sick people well or lightening the burdens of the incurable.

CHAPTER XVII

HIGH FREQUENCY CURRENTS AS GENERAL TONICS IN THE DEBILITIES OF SICKNESS

Physiological Basis for the Great Influence of this Remedy on Nerve Tone. Its Tonic Benefits in Many Conditions. The Crises in Acute Prostrating Disease. To Restore Strength in Convalescence. The Chief Tonic for Rapid Recovery. The Antidote for Acute Mental or Physical Exhaustion. Treatment of the Effects of Nervous Shock and Prolonged Grief. Nature's Invigorator.

PROBABLY more people have an idea that they need a "tonic" than any other remedy of the druggist. Probably the prescription most frequently written by the majority of doctor's is a "tonic" of some sort.

The word means, "producing and restoring the normal tone; an agent which tends to restore normal tone." In order to understand the relative place of electricity as a *tonic* we must compare it with other tonics of the *materia medica*. These are classified according to their most definite action, for there is no *drug* which acts upon and braces up the whole system as a "general" tonic. Only the great *physical* agents belong to that class. The local tonics are:

1. *Cardiac tonics*: "those which strengthen the heart's working power."

The drugs cited in this class are such as digitalis, strophanthus, and strychnine. They are spurs to action rather than suppliers of more power to work. They serve us well in emergencies. In prolonged use nature falters under the unrelenting spur, as a tiring horse finally ignores the whip, and the further use of any of these drugs is dangerous, injurious, and may be fatal. They are therefore not true *tonics*.

On the other hand turn to our Chapter VI and follow the

genuine increase of working *power* that results when nature within the body converts the energy of an electric current into her metabolic energies and *adds them to her own*.

Here we have no whip and spur to merely prod the tissues on (though in their place both whip and spur are conquering forces and electricity is both of them), but to these incentives to greater effort two things alone supply the fundamental increase of true tonic-power for greater work without reaction—nutrition and electricity. The high frequency current enters the tissues with new vigor for deposit in them, reinforcing the store of nature's vitality by a physiologic increase. No drug remedy has the power to do this.

2. *Digestive tonics*: "those which aid digestion in the stomach or intestines."

The drug remedies in this class are too numerous to mention and are of direct value in their place—the place of a temporary crutch to limping nature. But what we call digestion is but the first process in nutritive metabolism, and our previous chapter shows how the physiological reinforcement of the high frequency current influences the normal secretion of digestive juices, the toning of all the nerves of blood-supply, the muscular movements of the alimentary canal, the assisting functions of glands, and beyond these promotes the intake of increased oxygen for more active oxidation and energizes finally the absorption of the digested food and the elimination of the products of waste. Both these tonic resources belong to good prescribing but the deeper and lasting benefits that arise from restoring the normal tone of all the cells, nerves, tissues and glands concerned in digestion are more nearly within the "tonic" action of a physiologic stimulus than of a drug stimulus.

3. *Hematic tonics*: "those which improve the qualities of the blood, such as iron, arsenic, manganese, etc."

These are very necessary blood-foods in many cases, and when they can exert effective action upon the blood great benefit is derived; but some impediment to absorption and

action may often prevent results. Many a case of anæmia has taken iron for a year with no apparent rescue from the condition. But it is the great merit of the true physiologic action of electricity that it helps clear the impeded channels of absorption and enables other blood-foods to reach their destination and fulfill their mission.

This is the aid it lends to iron and the chief drug hematic tonics, but the direct influence of the high frequency current in improving the condition and quality of the blood has been made plain in Chapter VI and if the reader will compare the scope of this "tonic" with any one of the drug tonics for the blood the relation of each to the anæmic patient can be understood and appreciated.

4. *Nerve tonics*: "those that increase the tone of the nervous system."

To this class belong such drugs as arsenic, zinc oxide, strychnine, phosphorus, muriate of ammonia, quinine, etc. Arsenic and phosphorus are most nearly nerve foods. All of them meet difficulties in fulfilling their mission. They often disappoint us because the loss of nerve tone which they are trying to repair may have causes beyond their reach. Nor is any one of them able to definitely produce the state of "tonus" in a nerve fibre so that it can be demonstrated. Electricity *can*. It is one of its distinctive powers, demonstrated for many years.

Says Howell: "The altered physiological condition of a nerve during the passage of the electric current is designated as *electrotonus*. Electro-tonus expresses itself as a change in the electrical condition of the nerve which gives rise to nerve currents known as the *electrotonic* currents—these originating in and belonging to the nerve itself." This ability to increase the functional power of nerves is not shared in like manner by any other remedy in medicine, and although it is but one of the complex tonic properties of electricity it would alone suffice to place it in the front rank of "nerve tonics." Its reputation as the greatest of this class is entirely deserved.

5. *Vascular tonics*: "those which increase the tone of the blood-vessels."

Drug agents in this class are such as belladonna, ergot, etc. Each has its place in treatment of special conditions. In one field ergot is unrivalled. In another and distinctive way the wonderful belladonna is scarcely surpassed in swiftness and precision by electricity itself, but both these remedies act for themselves when simply swallowed, while an electric current must be directed and controlled. It can then be made to do what nothing else in the art of medicine can duplicate or even approach. Granting to all other vascular tonics the importance each possesses, in its own sphere electricity stands alone and in certain ways outranks them all. It is our only means of driving renewed circulation through a wall of vascular stasis, and its influence upon the vasomotor nerves and muscle-fibres makes it the local instrument of precision in this field.

6. *General tonics*: "those which brace up the whole system."

Authorities cite no drugs in this class but mention *electricity* and *exercise*. When the reaction from exercise is invigorating and not exhausting it is nature's chief tonic (except food), and electric currents afford our only means of imitating the muscular contractions of nature. With this in mind and with the clinical picture of tonic drugs before us we may now review the tonic properties of high frequency electric currents. It will take but a moment and the education will repay us.

Taking high frequency currents in their entirety and their various modes of administration we have in them a powerful tonic to all nerve cells, nerve centres, nerve endings, and nerve functions, both of the sympathetic and cerebro-spinal nervous systems and the nutritive energies of the trophic nerves; a potent tonic to the tonicity of muscle-fibres, the walls of blood-vessels, the force of the heart, the peripheral blood-pressure, the functions of vaso-motors, capillaries and veins; an ozonizing tonic to the blood, to the

red cell pigment, to the number of red cells, to the production of oxyhæmoglobin, to the activity of its absorption in metabolic exchanges, and the activity of phagocytosis; a tonic to the energies of respiration, the intake of oxygen, the activity of oxidation, the conversion of protein waste into urea and the destruction of uric acid; a tonic to the completion of combustion in the tissues, the production of heat energy and the maintenance of normal temperature; a tonic to the functional activity of the lymph vessels and absorbents and all the processes of absorption; a tonic to the secretions of glands and the excretory functions of all the organs of the body from liver and kidneys to skin; a tonic to nature's exercise and energy; a tonic to appetite and relish for food; a tonic to the elementary processes of metabolism, and physiologic stimulus to the living human machine.

The reputation of electricity as a general and special tonic is won by merit. Yet how few have known its value. It is as if the wealth of the Rand had lain open to our reach and been all but universally neglected.

Let us now turn this superb tonic to specific use. Certain diseases are characterized by extreme weakness of the patient at some period of their progress, and hence are called "asthenic" (without strength) in contrast with others in which this degree of debility is absent. Severe diphtheria is such a disease. Pneumonia is another. A point of exhaustion is reached in many cases when the effort to sit up in bed may cause heart failure. During these anxious hours when the feeble powers of life must be reinforced or flicker out (and whenever weakness of far less degree requires a tonic) add the tonic help of high frequency currents to any other measure that is prescribed.

Direct the nurse in attendance to gently apply a tonic dosage to the spinal nerves, moving the glass vacuum electrode up and down each part of the back. Next apply the same form of administration to the chest, and also have the patient inhale the ozone from the tip of the electrode. A

couple of moments inhalation is enough. The entire treatment, modified in extent according to the feebleness of the patient, can be repeated night and morning with marked benefit. Try it in typhoid and it will rejoice you.

The restful and energizing effect of this great sedative tonic and stimulus to recovery should be continued throughout the illness as an important part of the treatment, and when the patient is getting well—is convalescing—the same tonic is of equal importance to hasten and support the limping steps of nature in the quick recovery of the sound state. Not every person gets entirely well after an acute illness, and many linger months and years upon the way.

Neglected “convalescence” injures men, women and children. A “sickly looking child” should never be seen at school or on the street. The business man who turns from bed to business, unable to take the “vacation” advised to build him up, and dragging around an anæmic and feeble brain in a feeble body, should never be allowed to lack the nutritional and restorative tonic that is so easily within his reach. The high frequency current will do more good than a vacation accompanied by worry and fretful impatience to be home again.

The woman who rises from a sick bed to resume family cares as soon as the doctor consents and necessity compels, can still protect herself from a relapse and lift herself upward into health by the comfort and sustaining strength of this prince of tonics.

Many of the sudden and relatively short diseases of both children and adults leave “sequelæ” in their wake—tedious and disastrous as they are often needless. Infectious diseases destroy the red blood-corpuscles and leave anæmia behind them. Deficient nerve-tone, organic or functional debility, a lowered state of nature’s tissue-resistance to contagion, follows too often on the accidents and illnesses of life. Relapses also occur and cause or prolong anxiety.

In other cases an unhealed wound of disease may serve as the focus of later mischief, as, after measles or pneu-

monia, a condition may be left that invites consumption, and after an acute inflammation of the kidney we may discover albumin in the urine despite all that medicinal treatment can do. In all these cases the tonic influence of high frequency currents upon the metabolism of the tissues makes this remedy of the first importance to carry recovery to completeness. It should never be neglected in tardy convalescence.

As a *quick* antidote for sudden mental or physical exhaustion no other remedy can do the work of an electric current—not even natural rest and sleep. Rest and sleep and food are vital to maintain the benefits, but to sweep from the oppressed nerve centres the toxins of fatigue and refresh them with inspiring oxygen and restored nerve tone the resources of electric currents surpass all others. This is especially true in that common state known as “too tired to rest.”

During a time of great public excitement a young man was kept at high-pressure work in his office for twenty-two consecutive hours. He was allowed two hours to sleep and was required to resume work for a full day more. He spent fifteen minutes of his valuable two hours of rest in taking an energizing tonic of high potential electricity *and it carried him through.*

Like the bracing ozone of the sea it swept the carbonic acid out and oxygen in to the wearied centres and refreshed them with the natural rest of a long sleep. He did the next day's work successfully and then resumed normal hours. Strong coffee has some repute for this purpose but it is as a noxious poison compared with the clarifying uplift to the nervous system of high frequency currents.

The explanation of part of this effect is simple. Nerves in an atmosphere of carbon dioxid lose their excitability, but recover it in an atmosphere of oxygen. The electricity renews the normal *oxygenization* of the tissues. Carbon dioxid is one of the great products of work and in fatigue is present in excess. Slow elimination means slow rest,

quick elimination means quick rest. Nature cannot do it alone half so well as with the aid of an eliminating tonic.

Sudden calamity, the startling fear of disaster, some overwhelming news or cruel loss may produce the condition known as nervous shock. We have only to define this type of breakdown to at once make clear the action of electricity in restoring the normal nerve tone. The word shock is applied to any sudden vital depression of the nervous system, especially inhibiting the vaso-constrictors of the great abdominal vessels, and relaxing the tonicity of the normal state *as a collar wilts when the starch is out*.

The brain centres become suddenly anæmic, the solar plexus is "kicked in the stomach," the functions of glands are arrested, the liver clogs, digestion is deprived of working force, and the vicious circle repeats itself until the patient is rescued from the state. Severity is a matter of degree but the principle is the same in all cases.

The tonic stimulus of electricity is decisive in restoring nerve tone. That is all that the treatment of shock calls for. When nerve tone is restored the vaso-constrictors, glands, cells, heart, blood-vessels, nerve centres, all resume where they left off and the state of "shock" ceases. But when not effectively treated it may last in slowly lessening degree for many months and for many years. Some time ago we treated a patient for shock whose condition dated from an appalling theatre fire twenty-eight years before. She had escaped, but the panic, the crushing and trampling struggle in the crowd, the memory that haunted her of flames and burning lives and nearly three hundred deaths, made and kept her a nervous wreck until a potent current of electricity restored her lost nerve-tone.

Grief is a disease when it chokes functions, clogs the liver, burdens the brain with uneliminated toxins, and adds starvation to loss of appetite. It has passed from the sphere of the emotions to a pathological degeneration of tissue. Autopsies show that in this morbid state the nutrition of tissues is impaired and the substance of various vital organs

undergoes the same kind of degeneration as that caused by the germs of infectious disease.

Mere mental effort in the ordinary round of travel and search for diversion is vain advice and of no avail until some outer stimulus restores the lost tone of the nerves. Nature needs assistance to do it and an electrical stimulus is nature's right hand in the work. It is incomparable in swiftness and efficiency.

Sorrow, grief, extreme emotions, and all great misfortunes should be regarded as conditions similar to acute infectious diseases, which they resemble in result and tissue changes, and recovery from them should be treated as convalescence from such diseases. It is rational and wise to shorten their duration by the aid of high frequency currents, and rescue friends, family and the victim from needless and avoidable harassments.

Excessive brooding in unreasoning grief does no one any good. The panic-fear which takes the place of confidence and courage in the state of nervous shock reacts for harm on every undertaking of the victim. Judgment is lost and failure springs where success should blossom. We have had abundant opportunity of confirming in our practice the tranquilizing potency and sustaining power of electricity in cases of overwrought emotions and in the profound melancholia of sorrow and the despair of shock.

CHAPTER XVIII

TREATMENT AND RELIEF OF SYMPTOMS BY HIGH FREQUENCY CURRENTS

The Treatment of Certain Common Symptoms Requiring Relief in Many Diseases. Pain. Counter-Irritation in High Frequency Treatment. The Tesla Pocket Instrument. Excessive Nervous Irritability, Insomnia, Cough and Profound Prostration. Superiority of the Physiologic Actions of Electric Currents over Drug Depressants.

WE shall now consider high frequency currents in the treatment of those diseases in which they are useful links in the chain of curative measures, or are adequate alone to render all the benefit that is required or possible in the case.

But there are certain common distressful symptoms attendant on many diseases, and the patient wants relief from suffering without waiting for a cure. Of these voices of sick tissues that demand the first concern of the physician we shall here discuss five of supreme importance; pain, excessive nervous irritability, insomnia, cough, and profound prostration. Whatever may be their cause these keep the organism depressed and retard recovery. After dealing with them in this chapter we shall take up the orderly treatment of common diseases.

Coal tar and opium are the great storehouses from which have been extracted the anodynes and hypnotics and nerve sedatives in common use, and strychnine has done duty as head tonic. Every one knows that they are all swords with two edges and foes of vitality—omitting strychnine, though this drug is the worst abused "tonic" in the pharmacopeia and in the large doses often prescribed is an aggravating irritant to the spinal cord and its prolonged use is injurious in several ways.

Ten minutes after a cat partakes of a morsel of meat containing one-twentieth of a grain of this favorite tonic she will look thoughtful and introspective. Within five minutes she will give a convulsive leap, a few shivers, and her body can then be disposed of as circumstances permit. This illustrates the action of the wonderful alkaloid of *nux vomica* on the spinal centres.

The drawbacks to opiates, chloral, cocaine, antipyrin, etc., are too well known to call for comment.

So the danger of "drug habits" warns us against the too ready use of injurious and non-curative sedatives for cough, insomnia and pain. As recovery by "removal of the cause" is often a slow process humanity asks and the patient urges a speedier means of relief. In this extremity electricity comes, offering its potent powers of palliation unmixed with unpleasant bye-effects or depressions of any kind. And when comfort comes at its command, and weary tissues revive and rest from pain, it possesses the enormous advantage over emergency drugs that at the time it is affording temporary relief it is also imparting a general nutritional benefit. Moreover, its "temporary" reliefs are sometimes very long lasting.

These facts make this remedy our first choice in the conditions requiring it, and when we find that it cannot be made to abate the suffering in the individual case it is then soon enough (and not before) to resort to opium or its alternatives.

PAIN.—General electrification with the high frequency current will tend to remove the vague discomforts of vasomotor disturbances and will relieve some headaches, but has little power to combat sharp localized pains of any kind. These require local treatment, and in the main, treatment with the discharge through the glass vacuum electrode is most commonly the means to use.

Select for use on the surface of the body, an electrode with the usual oval bulb end and connect it by an insulated conducting cord to the terminal of the high frequency appa-

ratus which produces (on test) the fullest luminous glow and discharge of current through the electrode. Connect the patient by another conducting wire to the opposite pole of the apparatus, which should be grounded to give the greatest difference in potential. Dust toilet powder on the dry skin.

The mode of application and regulation of the dose will now be governed by the character and location of the pain. If it is situated in tissues overlying bone, with little soft covering beyond the skin, and if the pain is somewhat diffused, the electrode must also diffuse the current by being moved over the affected surface and nerve end-plates.

With current at zero place the bulb of the electrode in gentle contact with the part, increase the current from zero up to the intensity which causes the patient to report a comforting sense of warmth without irritation. Then with gentle, slow and even pressure, move the contact to and fro over the indicated area, taking care not to lift the bulb from close contact with the skin. In a moment obtain a report from the patient as to the effect produced and if it is progressively comforting continue the application until either entire relief is obtained or as near to it as seems possible at the one application.

If the pain is sharply localized in a small spot do not keep the electrode in motion but press it upon the spot and hold it there until the sense of heat requires you to move it aside a moment. With alternate steady pressure up to the point of tolerance, and reliefs by lifting or moving the electrode, continue the treatment until the maximum benefit is produced.

If the pain is deeply situated in soft parts, such as the lower abdomen or ovarian region, do not simply press the electrode upon the surface. Select an electrode with a smaller end and make *deep* pressure while the patient forcibly lets her breath out and draws the abdomen in as flat as possible. This decreases the distance between the seat of pain and the electrode, gets the current into closer action

and will often secure results when an ordinary surface application would fail. Here also the great art of "letting up" must be practiced, as with an effective dosage the electrode will feel too hot for comfort if held steadily without respite. Divide the treatment into several applications to suit the comfort of the patient. See Instruction Plate No. XIII.

These have been "sedative" intensities of current such as most neuralgic pains and those marked by extreme tenderness of the tissues require. But another large group of pains rebuff sedation and yield only to the opposite action of a counter-irritant.

In these cases the intensity of dosage may be regulated in either of two ways. If you have commenced with a sedative dosage and find that it is not efficient lift the electrode from direct contact and create a small air gap between the bulb and the skin. By testing the intensity and effect (and by asking the patient to report on the matter of relief) ascertain the degree of irritant stimulus that produces the most benefit and complete the treatment accordingly.

Or, instead of the resistance of an air gap to intensify the discharge apply the current through a sufficient thickness of woollen clothing, or place over the part one or more layers of fine broadcloth kept for this purpose. The efficient dosage can be thus regulated and treatment, with the electrode in motion, continued until the desired relief is obtained. The rate of movement of the electrode is to be as slow as the comfort of the patient will permit, for a mere rapid manipulation over the parts would not give the current time to act. But if high intensity is required for a decisive effect and more rapid manipulation is necessary, divide the treatment into several installments, with a rest between.

In this class of cases we must also consider the spinal ex-its and tender points in the course of affected nerves, as well as the terminal expression of the pain. Apply the same method wherever needed until the maximum of benefit has been secured.

At this point, because it is appropriate and of endless

clinical help in the treatment of patients with the high frequency current—a sedative-*irritant* of the first class—we shall cite the remarks of Hare on counter-irritation, and Hare is a competent medical authority whom none will dispute. Read what he says and apply the principles to conditions suiting them.

“*Counter-irritation* is the term applied to the use (in treatment) of substances which excite the ‘irritability’ of the nerve-endings and tissues of the local area of skin with which the irritant substance is placed in contact.

“The basis of counter-irritation rests upon reflex action, or the inward conduction of a nervous impulse to a centre, which, in response to this stimulus, sends out a direct impulse to the diseased part of the deeper tissues which are the terminal of the outward nerve fibres from the same centre.

“Counter-irritation is employed for the purpose of influencing morbid processes in more or less distant parts, or of affecting the general system. It is based on sound physiological laws. Its uses are:

- “1. To reduce congestions and inflammations.
2. To promote the absorption or removal of inflammatory exudates or deposits after true inflammation has ceased.
3. To relieve pains of various kinds, especially those caused by the pressure of engorged blood vessels on nerve filaments.
4. To affect the general system by causing a reaction in some systemic diseases.”

Application.—“The proper manner of employing a counter-irritant to affect inflammations is not to apply it directly to an inflamed area, but a little to one side of it, or at a spot known to be intimately connected with the diseased area by nerve-fibres.

“Thus, in diseases of the eye the irritant should be applied back of the ear or on the temporal region. In abdominal neuralgia or pleurodynia the best results are reached, not from an application to the spot where the pain is felt, but to the point of the spine where the nerve at fault makes its exit. The reason for this is that pain is always referred to the peripheral end of an irritated nerve.

"Among the inflammatory affections in which we find counter-irritation very serviceable may be mentioned pleurisy, pneumonia, iritis, ophthalmia, rheumatic or traumatic synovitis, acute or chronic peritonitis, enlarged joints, and inflamed glands. In all these states and a host of other sub-acute and chronic inflammations counter-irritation is to be resorted to. For the relief of pain moderate irritation is effective, and every one who has had stomach-ache and remembers the relief of a mustard plaster can recognize the value of this means of treatment. It only remains to state that headaches are often amenable to similar treatment. These headaches may be neuralgic, or due to dyspepsia, or to cerebral anæmia or congestion, but counter-irritation will nevertheless do good."

Formerly a drawback to the employment of this remedy in family practice arose from the cumbersome nature of the apparatus. At present stationary office equipments are supplemented by smaller semi-portable, and by still smaller portable high frequency appliances yielding sufficient current to treat many conditions. This is widening the usefulness of an adjunct remedy which can well be prescribed at some stage of almost every serious illness, and afterwards to hasten convalescence.

But to make the use of high frequency currents as widespread as the profession a still greater convenience of portability is required together with an extreme simplicity in both instrument and technique. The author remembers attending a medical convention in New York City in 1894, during which a speaker stated that physicians who used electrical apparatus needed, more than anything else, the co-operation of electrical engineers and their inventive talent for the construction of better and simpler apparatus which the doctor could better use.

Fifteen years have elapsed since then. Progress in the desired direction has been made. Manufacturers to-day consult and employ technical experts who have revolutionized the appliances of 1894-1900. We have seen that the name of Tesla is linked inseparably with the high frequency

transformer and in the early nineties he drew attention to the marked therapeutic effects of large apparatus experimentally operated in his laboratory. A recent pocket instrument of Tesla design is herewith illustrated to serve the practitioner at the bedside. It combines the twin requirements above stated and can be operated wherever a lamp socket is available. It has a current consumption of from twelve to thirty watts. Its "frequency" is estimated at 400,000 and its potential at 75,000 volts.

For the family physician, he whose practice is at the bedside and who thinks he has no time for office apparatus, this little device is the portable instrument *par excellence* for family uses—for fathers with the fatigues of business, mothers with the worries of the house, daughters in school or in society, sons till they mature, babies anywhere.

Neat, compact, as easily carried as a stethoscope, its dosage regulated in its construction, safe and agreeable in treatment, making no difficult demand on skill, competent to relieve many conditions, helping where drugs need help, admirable and pleasing within its limitations, the pocket Tesla high frequency transformer might well be in every doctor's hands. It will be as fast as its acquaintance is made and its value known.

NERVOUS IRRITABILITY.—General electrification with the high frequency current is often calming to this state, especially if elimination of internal irritants is hastened. With the patient recumbent upon the "auto-condensation couch," or sitting in a condensation chair, or in any ordinary chair supplemented by an "auto-condensation pad," connect the patient to one terminal of the current and connect the other terminal to the insulating pad, seat, or mattress. Increase the current from zero to not more than 250 milliamperes at the first treatment. In ten minutes cut off the current and await report of results at next seance. Increase dosage and time according to effects.

Either in addition to this general saturation of the system with an alterative-sedative charge, or in place of it, have the

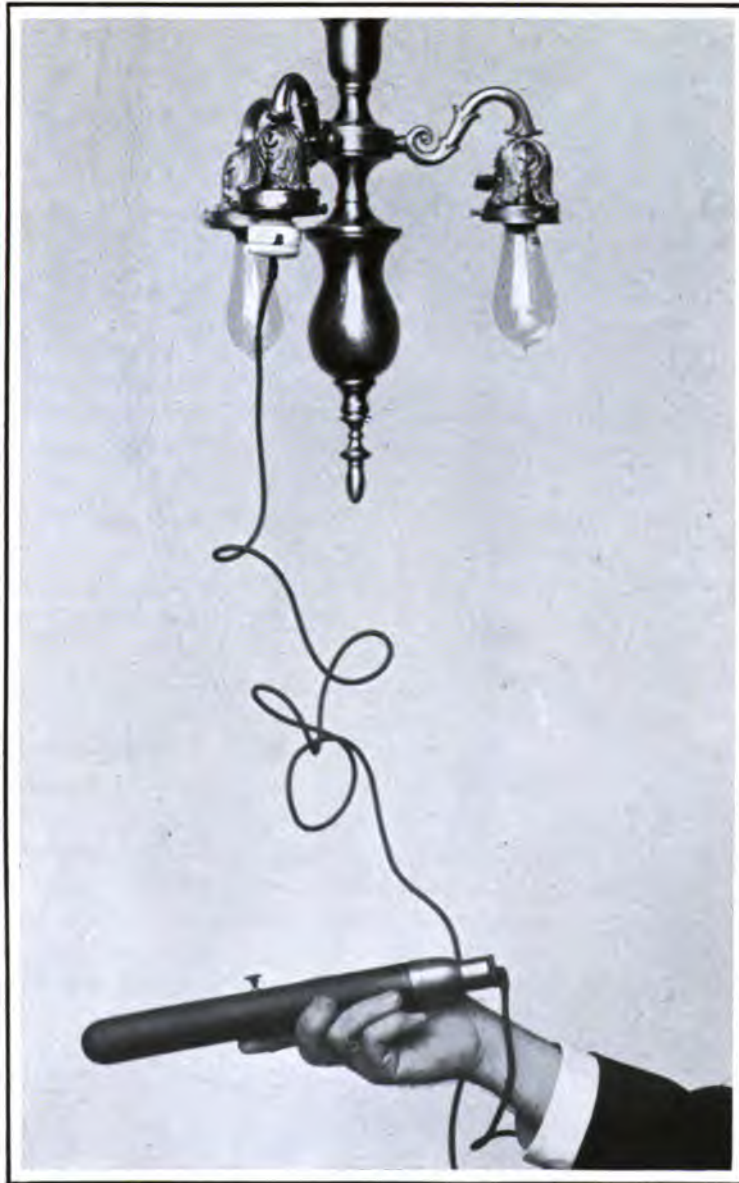


PLATE XV.—Illustrating a pocket high frequency instrument, complete and ready for use when connected with any electric light outlet. It comprises a charging coil, circuit interrupter, condenser, and primary and secondary coils, and is the only Tesla transformer ever brought within so small a compass. With the current on, pressure on the thumb screw starts the instrument into action; releasing the pressure stops it. It is useful in the field of external treatment covered by regular vacuum-tube discharges, and in the liberation of ozone. Nearly all the directions in this book for local applications of vacuum-tube electrodes apply to the method of employing this compact device. It is a very beautiful product of the art of the Electrical Engineer.

patient recumbent in bed or on an operating table, with the spine exposed its entire length. Under the stomach place a wet pad electrode, or a metallic plate, connected with one pole of the current. Dust toilet powder on the back to secure the dry resistance needed, and also act as a suitable lubricant to the electrode. Select the usual "body" glass vacuum electrode and connect it to the opposite terminal of the machine.

Warm up the bulb with current before applying to skin, for it is never pleasant to startle sensitive nerves with a cold electrode. With the warmed bulb now pressed upon the lumbar spine turn on the current and increase it to the intensity that enables the patient to report a feeling of comforting and soothing warmth. Now with *expression*, and with mind intent on the effect to be produced by your direction of the current, manœuvre the electrode on each main segment of the great seat of reflexes and secondary centres—cervical, dorsal, lumbar, and sacral.

Carry the electrode well up the occiput, where a gentle current is extremely soothing. Do not confine the manipulation of the spine to the mere middle path of vertebræ but extend the sedative action of the current a hand-breadth on each side. Apply very full sedation across the lumbar region and especially search by deep pressure for all points of spinal irritation and tenderness, and on each point detected hold the electrode still or move slowly, until the tenderness is removed. When the fullest amount of sedation has been secured cut off the current and end the treatment. Dust a little toilet powder on the skin as a parting comfort and if the patient is at home in bed she should at once be left quietly alone to try to sleep, or if treatment was administered at the office advise her to go home and try to secure a restful nap.

Repeat treatment as often as required to obtain the necessary results. In office practice a daily treatment is advisable until relief enables the interval to be lengthened. But in acute diseases treated at the bedside the spinal application

can well be made twice or even three times daily until the patient passes the worst stage, and then a daily treatment until necessity ceases.

INSOMNIA.—If the direct cause of wakefulness has been the distress of pain, use the high frequency to remove the cause. If sleep has been banished by over-excited nerves, apply high frequency sedation to the spinal centres. If there is no apparent cause listen to the stomach and intestines and if the sounds of fermentation are heard combine an internal corrective with the external sedative, for the prime cause of more insomnia than any single and soft-spoken cause elsewhere is the sportive play of gas bubbles in the alimentary canal. References to the benefit of high frequency currents in inducing sleep will be found in our narrative chapters of Part I. In safety of action and quality of sleep obtained when the desired sedative effect can be produced, nature alone rivals electricity in this field.

COUGH.—Press the tip of the glass vacuum electrode deeply into the depression above the sternal notch, start the current into action and increase the dosage until the intensity is just short of irritant. While this dosage is being made to set up a mild counter-irritant sedative effect request the patient to make a series of swallowing movements of the throat muscles, and also to clear the throat by a few voluntary coughs. These acts bring the muscle-fibres into altered relations, induce vasomotor changes, disturb the nerve filaments, and materially help the current to perform its work. If deep pressure at this point will, on test, set up a cough, the application will allay the irritation and relief will follow.

Repeat the same application for additional action with the electrode pressed on one side of the larynx. Repeat on the opposite side.

If the severity of the cough and the causative conditions require it, make labile (moving) applications of the electrode down the region of the trachea in front and on the cervical spine, in both these areas increasing the intensity



PLATE XVI.—Illustrating Author's method of treatment of throat or vocal organs in cases of congestion, hoarseness, loss of voice, or inflammatory or painful conditions in all classes of patients, but especially in the throat affections of singers, speakers, actors, and victims of acute or chronic "colds." With the proper current in action, press the electrode deeply in the depression above the supra-sternal notch and instruct the patient to forcibly stretch the muscle-fibres of the larynx and related organs by movements of swallowing, saying "ah!" running the musical scale, etc., etc., alternated with moments of rest. Repeat the same process upon each side, with pressure of electrode externally over one tonsil and then over the other. The deeply penetrating current acting upon the muscle-fibres and blood-vessels while thus exercised, rapidly abates congestion and inflammation, induces a new blood-supply, tones up the nervous mechanism and produces benefit with remarkable certainty and quickness. In value to singers and speakers it outclasses all other means of treatment directed to the same end.

of current to a higher dosage for a more stimulating and reddening action.

Repeat according to the needs of the case. At each treatment persist until the effect of sedation is secured, regardless of whether it takes five minutes or fifteen. The greater the volume of current in the dosage the quicker it can be made to set up the action desired. This is also true of all applications of high frequency and high potential currents of electricity.

While a number of drugs of innocuous nature enter into the cough prescriptions of the profession yet none are nutritional or tonic and if they fail to relieve the cough the less said of them the better. But the three sheet-anchors in the control of cough belong to another class. They are alkaloids of opium and are subject to enormous abuse. These three (morphine, heroin, and codeine) lull with the syren's song and smooth the pathway of the advanced consumptive to the grave, but they are not curative nor in the nature of useful additions to the general metabolism. When not an emergency benefit they are distinctly harmful.

No more than a word should be necessary to point out the immense superiority of restorative, tonic, nutritional, electrical sedation—allaying irritability with physiologic action, toning the nerves and blood-vessels, reducing stasis and congestion, improving the local nutritive activity, and reinforcing nature in every step of her processes. We have no analogue or equal in the *materia medica* to the influence of electricity upon coughs. In our remarks on tuberculosis we shall say more about it.

PROFOUND PROSTRATION.—Commence treatment with a tonic labile application of high frequency current to the entire spinal nervous system, for electricity is the nerve tonic *par excellence* of the medical art. Use the glass vacuum electrode. Intensify the dosage up to the point of irritation, then reduce it just below this point and administer the treatment with this stimulating energy.

In a case of acute prostration or extreme debility in the

course of chronic illness make the first application short to avoid fatigue, but repeat it at least twice daily (or oftener if necessary) according to the reaction obtained.

If the reaction is favorable and the patient can be turned, extend the application as soon as feasible to practically the entire body, for the purpose of toning the vasomotors, stimulating an increased circulation of blood through the surface capillaries, energizing the nerve supply, and warming and strengthening the whole system. Use the vacuum electrode over the entire surface, doing successively each portion of the trunk and each limb in turn. It will take a little time, but a nurse can do it easily with the simple Tesla instrument, and the results will be found "worth it."

CHAPTER XIX

AFFECTIONS OF THE NERVOUS SYSTEM

Nervous Diseases and Nature. Principles of Treatment. Affections of Motor Nerves. Treatment of Vasomotor Conditions. Diseases Affecting Sensation. Trophic Nutritive Disturbances of Nerves. Reflex Symptoms and Treatment. St. Vitus' Dance. Treatment of Hysteria. Paralysis Agitans. Mental Disturbances and the Importance of High Frequency Currents.

To simplify the understanding and to better make plain the applications of physiologic *stimuli* in aid of nature in the treatment of nervous conditions we shall consider them from the stand-point of physiology instead of by the complicated system of diagnosis. In this we follow nature's plan.

In health the phenomena of life are carried on at the normal rate of activity. Departures from the normal rate are called "disease." A "departure" may be an increase, decrease, or arrest of the normal rate. This applies to all the processes of all the tissues of the living body. Health is restored by restoring the normal rate of exchange in the tissues affected when it can be done.

While the nervous system dominates all others, and nerves have been called the Generals of the body, yet they in turn are at the mercy of metabolism, which they direct but are subject to the limitations of their powers.

The phenomena of nervous tissues (cells, fibres and end plates) are motor, vasomotor, sensory (including special sense), trophic (nutritive), and reflex, and the normal rate of any or all of these may be increased or diminished and express the condition of disease. We will consider them *seriatim*.

Any part of the nervous system may become the seat of

disease, hence writers classify, "diseases of the brain," of the "spinal cord," and of the "nerves" in the distributions of their fibres. We also have diseases of the functions of nerves, and of the central entity known as the "mind."

But an examination of the morbid states of this system shows us again, what we so commonly find in the circulatory system, that apart from reflex derangements of function and tumors almost the whole long list of "diseases" is covered by the one pathology of inflammation or the results of inflammation; and in addition to this, by alterations of the balance of nutrition.

Hence, despite many and various names according to the situation and stage of the one chief disease-process, nature relies here upon her same few aids to restore the sound state which serve her throughout the body, and which succeed or fail in such measure as her energies are stronger or weaker than the foe.

Hence also the explanation why drugs do so little good in many cases, *for we do not possess any drugs which are curative of chronic inflammation anywhere in the body.*

Hence, finally, the reasonable wisdom of supporting nature with all the resources of physiologic stimuli. In degenerative diseases our physical energies may help nature but little at times, or at other times may do much, but much or little our main hope of doing the patient any good at all (of even a partially curative nature) is through the measures of physiologic therapy. If those who have jumped to the conclusion that electricity is of little value in *incurable* diseases will but examine carefully into the amount of value drugs possess in incurable diseases we have no doubt that the more hasty conclusions will be revised.

Drug therapy has a useful place, but in chronic diseases and in all but a short period of the course of most acute diseases, the restorative efforts of nature can be aided far more vigorously by physiologic stimuli than by the limited chemical actions of internal drugs. The best results are most often obtained by joining the forces of all three in

behalf of the patient—nature, physical agents, and drugs. This is our own plan always, in practice.

MOTOR PHENOMENA OF THE NERVOUS SYSTEM.—When the motor activity of a group of nerves is diminished the muscles supplied lose part or all of their motor power. The resulting paralysis may be partial or complete, and may affect the muscles in a curable or an incurable way, and this distinction should be carefully borne in mind when prescribing treatment. Permanent paralysis from destruction of central nerve cells is not curable by either nature or man, but in most cases the patient's general condition can be benefited by good treatment.

The principle of physiologic treatment of paralysis is to administer a dosage of electric current that will improve the circulation of blood through the tissues and compel the muscle-function of contraction. This most often means a muscle-contracting and counter-irritant dosage.

On thick groups of muscles the thick high-potential spark best affords this dosage, when the condition indicates its use. Apply daily at first and then three times a week until the maximum benefit is reached.

The alternate to this is the high frequency current of low potential and muscle-contracting action which simulates the faradic type. Employ it with the usual sponge covered electrodes.

In a case of facial paralysis from cold, the thin and sensitive tissues of the forehead can be warmed up and the stiffness greatly reduced by a counter-irritant high frequency dosage through the glass vacuum electrode. In all cases of paralysis the location, cause, and prognosis must control the selection of current, dosage, and method of administration. For a full study of this subject see the author's treatise on the treatment of disease by electric currents published some years ago.

Over-activity of the nervous function manifests itself in convulsions, tremors, and spasmodic movements such as chorea. High frequency counter-irritation upon the spine

is the main principle of treatment in all chronic conditions in which this remedy is indicated. In acute attacks the usual dependence is on other remedies. In chorea and in all cases with a possible cerebral involvement a sedative spray upon the brain centres should be added to treatment of the spinal centres. Sometimes there is an indication for a sedative dosage to the spine instead of counter-irritation and the physician should act accordingly.

Epileptiform convulsions occur in epilepsy, diseases of the brain, cerebral anæmia, uremia, infectious fevers, and reflex conditions referable to the digestive tract. As a restorative after the acute attack high frequency currents are of great value, as cited in a case of uræmic coma in our chapter on the heart. The rule applies to all.

VASOMOTOR PHENOMENA OF THE NERVOUS SYSTEM.—Vasomotor spasm is manifested by pallor and coolness of the skin with stiffness and “creepy feelings.” It is observed in disturbances of the sympathetics.

Paralysis of the vasomotors of a part is manifested by flushing of the skin, with a sensation of heat, and occurs as a symptom in hysteria, neurasthenia, and other functional neuroses, and follows injuries of sympathetic nerves.

Treat local heat and redness by a cooling high frequency spray, and local pallor and coldness by a counter-irritant dosage or thick spark. Add to the local treatment a counter-irritant application to the spinal centres with the glass vacuum electrode. In all irritable nervous conditions of the general system a general electrification of the patient is often one of the best sedatives—useful in many cases in practice which cannot be particularized in a book.

SENSORY PHENOMENA OF THE NERVOUS SYSTEM.—An increase in the sensitiveness of a set of nerves is called hyperæsthesia. In this state a slight irritant produces pain. Paræsthesia is a perverted state of sensory nerves and examples are numbness, tingling, itching, pricking, formications, etc. Lessened sensation is called anæsthesia.

When these alterations are caused by some manifest dis-

ease the treatment of the sensory nerves follows the indicated treatment of the cause, but when local symptomatic treatment is required we have only to apply the principle of *sedation* to the over-excitable state, and *stimulation* to the under-excitable state. Barring central destructions of nerve cells the action of electric stimuli in these variations of function is beneficial beyond criticism. It is the chief and often the only remedy, for drug action seldom reaches this far. Neuralgias of nerves are treated in another chapter.

TROPHIC NUTRITIVE DISTURBANCES OF NERVES.—Wasting of the muscle is the first effect of injury to its trophic nerves. Ulcerations from impaired nutrition also occur, bed sores being an example that combines both results.

When the cause is temporary or can be treated and removed the healing of trophic lesions and restoration of muscle tone is quickly accomplished by an electric current. But if the conditions result from the destruction of nerve centres only symptomatic benefits can be given the patient. Yet these often add to the comfort of life and may prolong it.

Do not wait till the stage of degeneration before giving a case treatment. In muscular atrophy begin as soon as possible to exercise the function of contraction and keep the fibres fed with blood. In threatened bed sore also begin before the tissues break down and aid the local blood nutriment by an electrical stimulus. A stimulating dosage through the glass vacuum electrode is one way to do it. An application of the lower potential high frequency current with faradic electrodes is another method.

REFLEX DISTURBANCES OF THE NERVOUS SYSTEM.—As we have seen in our chapters on *life phenomena* the nerve conductors reflect to a distant point quite a number of outcries caused by a focus of irritation somewhere else. Various headaches and neuralgias are of this description. The so-called "sick headache" is a vivid example. Certain backaches are reflex. The stomach, liver, rectum, and

uterus are great central-stations for the distribution of reflex annoyances to other parts of the body.

Treatment must search out the seat of the cause and apply the remedy there, when it is possible to do it. But often this is not within diagnostic skill. Hence local and symptomatic treatment is our only hope of help to the patient.

Now it is a very remarkable attribute of an electric stimulus that it evinces a disposition to follow the course of reflex conduction *both ways*. It will start from the sensory beginnings, travel with the afferent nerve to its centre, and then march down the efferent nerve to the seat of the reflex endings. When it gets there it will do its work as well as if we applied it directly to the internal tissues.

The value of this kindly attribute is inestimable. But still more: the same action can be reversed and we may apply our stimulus to the point of reflex termination and the current will go backward and trace the starting point

DESCRIPTION OF PLATES XVII AND XVIII

The two plates opposite show important areas marked on the skin for sedative, stimulating, counter-irritant, and other local applications to influence the organs and tissues indicated—for the relief of local pains, reflex irritations, localized congestions, diminished or altered secretion, impaired tonicity, functional derangements, and non-suppurating inflammations. Read especially our remarks on counter-irritation in connection with these plates and remarks on reflex actions in the first section of this book.

On the back of the body, within the field of *B* at the base of the brain, is an important region for counter-irritation. *C* is the surface over the cervical spine and its nerve centres, *D* the dorsal spine and centres, *L* the lumbar spine and centres, and *P* is the field of origin of nerves supplying the pelvic genito-urinary organs and sexual apparatus. The pulmonary area is defined by dotted lines. The right and left kidneys lie behind the fields *K-K*, and under the heavy dotted line *S* is the spleen. Reference to these Charts in connection with the chapters of Part I is especially interesting, and they do not half express the uses of high frequency currents on the trunk of the body.

On the front of the body, *L* marks the region of larynx, the dotted lines on the chest mark the pulmonary area, *H* is an important region for reflex actions upon the heart, and the lower border of the liver is drawn. Back of *G.B.* lies the gall-bladder. *S.P.* marks the anterior relation to the deep-lying solar plexus, and the dotted lines beneath it enclose the boundary of the pancreas. The lines at *A* locate the appendix and each *O* has a surface relation to an ovary.

and effect a removal of the focus of irritation in many cases when this focal origin remains undiscovered by the physician. It is the great property of a great remedial agent—unique in this. See Instruction Plates Nos. 17 and 18.

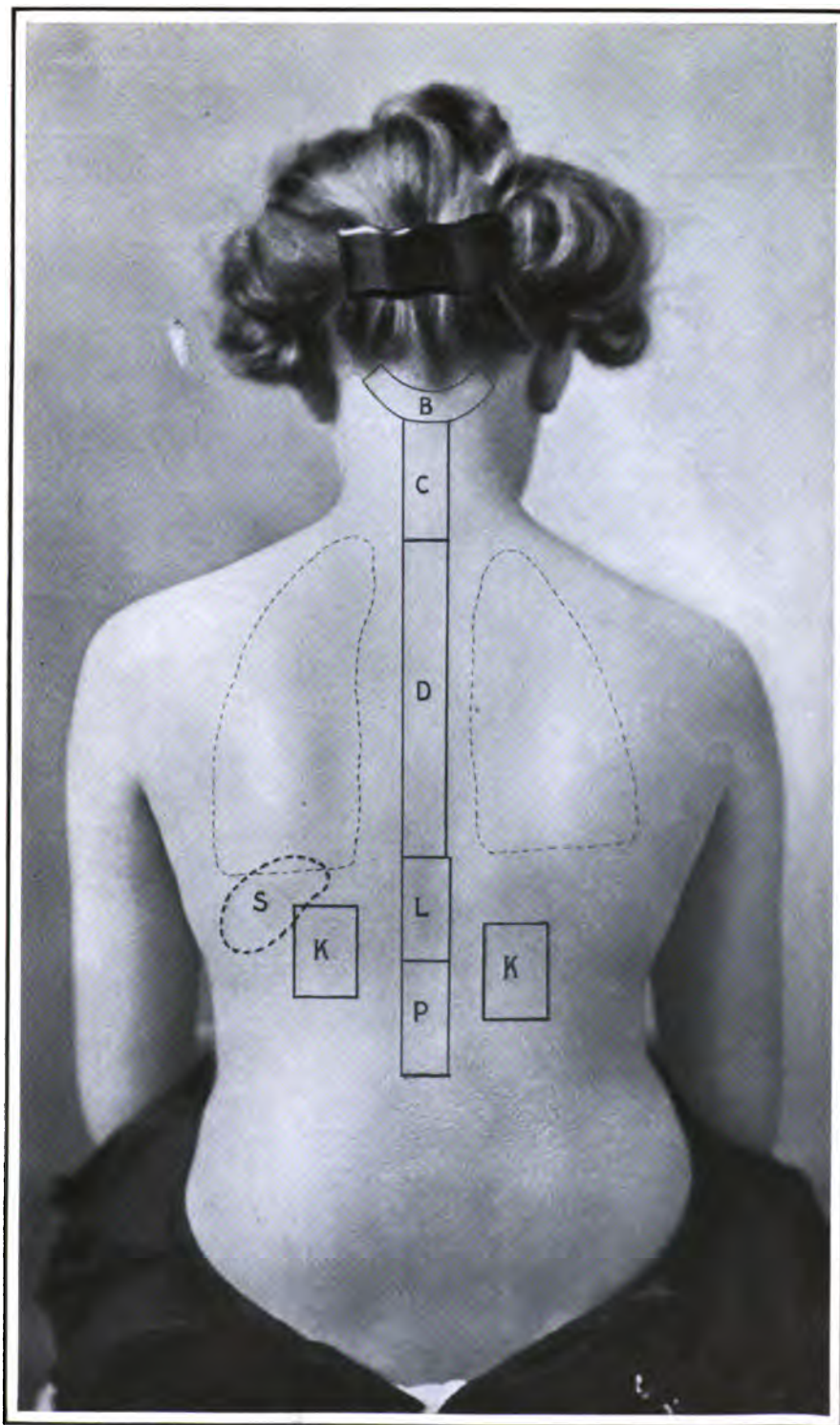


PLATE XVII.—Illustrating important posterior areas for sedative, stimulating, tonic, counter-irritant, and other local applications to influence the internal organs and tissues marked in outline. See description on page 300.

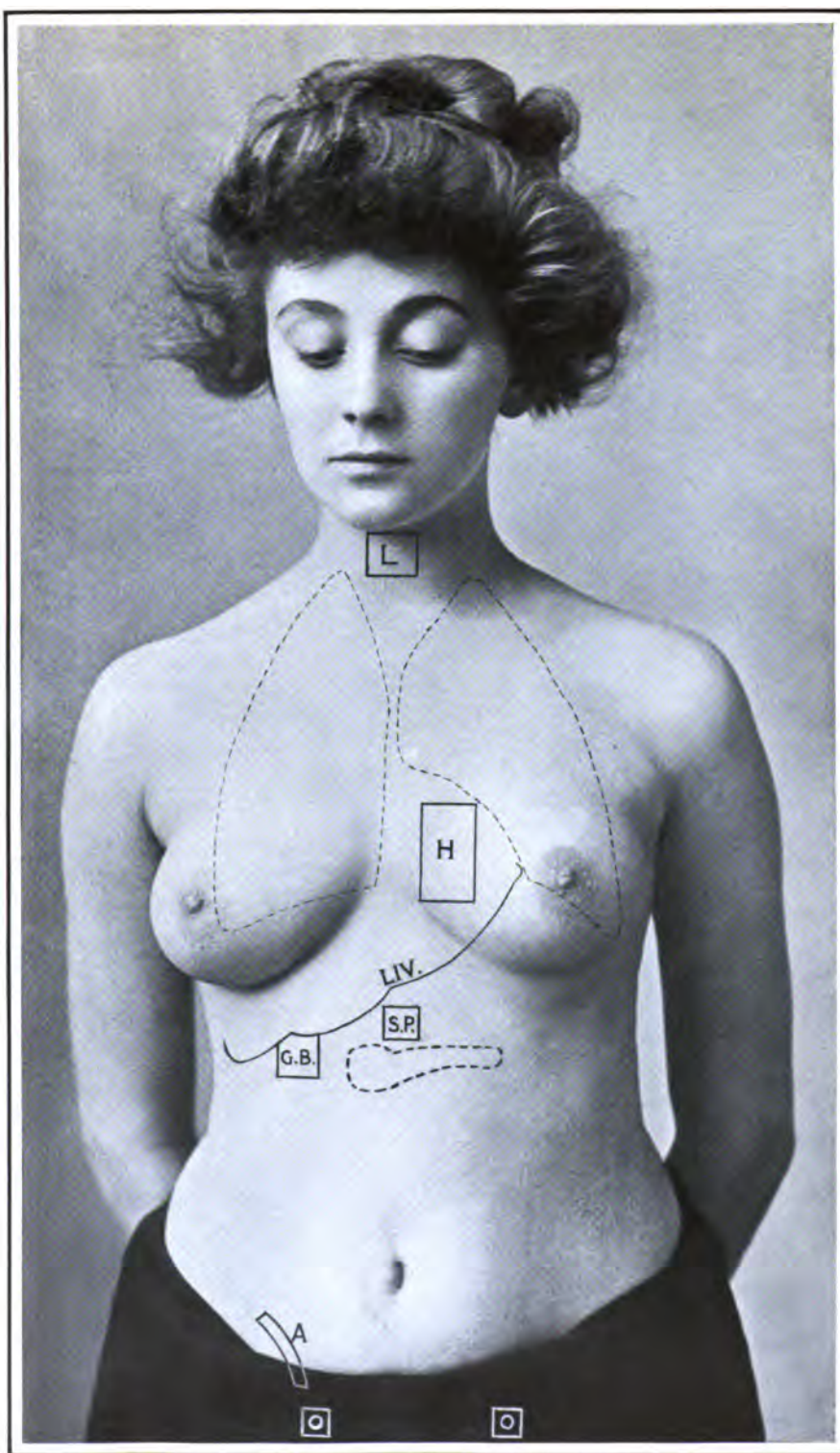


PLATE XVIII.—Illustrating important anterior areas for sedative, stimulating, tonic, counter-irritant, and other local applications to influence the internal organs and tissues marked in outline. See description on page 300.

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It is necessary to refer particularly to certain functional diseases of the nervous system and directions for the treatment of each will briefly follow.

CHOREA (ST. VITUS' DANCE).—The pitiful grimaces of the choreic child are far too little heeded by many parents. If but slight they are called a habit which the child is expected to "outgrow." No more grievous mistake can be made than to leave such a child to the "out-growing" mercies of uncertain time. Time is fickle and the child may carry the piteous evidence of neglect through a marred life.

Anæmia, lowered vitality, faulty action of the liver and bowels, and a general condition of neurasthenia is usually present in these cases. Prescribe whatever drugs and blood foods are indicated. Until the condition is controlled protect the child from painful embarrassment and nervous distress in all practical ways. Keep the bowels open and digestion free from irritation. If rheumatism is present treat it.

The most rapidly and certainly curative treatment of the nervous function (after attention to associated conditions as just directed) consists in a counter-irritant dosage of high frequency current applied to the entire spine until it reddens, and in girls, to the pelvic organs, finishing the seance with a sedative high frequency spray to the head—forehead, vertex and occiput. Repeat daily at first and then three times a week until recovered.

By sedative spray we mean one in which the dosage is regulated so as to set up *sedation* in the tissues to which it is applied. As the spray can be made to set up either a sedative, or stimulating, or irritant action it will not serve to simply use any spray that comes out of the electrode, as too many physicians do. Conform to the above directions or omit the spray.

HYSTERIA.—This term is applied to "a functional disorder of the nervous system, of the nature of which it is impossible to speak definitely but which is characterized by disorders of will, reason, imagination, and the emotions, as well as sensory and motor disturbances."

The discussion of hysteria would require a chapter. Drug habits are often formed by unwise prescriptions in these cases. As brevity is necessary here the physician should direct his high frequency treatment as taught in our chapter on neurasthenia, and also be governed by directions for special conditions and complications, according as he may discover them. We cannot repeat them as would be necessary if we attempted to fully cover the subject of the treatment of hysterical patients. But search this book.

PARALYSIS AGITANS.—Shaking palsy is a disease of unknown nervous pathology. Improvement often results from treatment in early stages but in the late stage a patient may resist all the resources of medical knowledge.

Direct high frequency treatment to metabolic equilibrium. Aim to set up sedative-tonic actions upon the cerebral and spinal nerve centres. Abate local symptoms or complications as they arise.

General electrification may be alternated with local applications with the glass vacuum electrode, and spray for local sedative effects on the head.

MENTAL DISTURBANCES.—The profound necessity of applying preventive measures to the rescue of borderlanders from the end in an asylum must impress all students of high frequency currents with their importance in the early deviations of health from normal. Their growing use in institutions for the treatment of mental cases and the still greater use they will certainly have in the future seldom means more than palliative benefits, for the remedy is then too late.

But most cases of the various kinds classed under the head of "mental" have a physical beginning. The physical tissues of the body initiate the disease. The symptoms can be observed and the warning heeded. With this efficiently done a great number of cases would remain useful to the community and a comfort to their families and themselves. To restore metabolic equilibrium must be to a great extent the aim of preventive treatment. Apply the methods taught in this book.

CHAPTER XX

NEURASTHENIA, NEURALGIA AND NEURITIS

Treatment of Neuritis. Neuralgia and its Treatment. Neurasthenia the Americanitis of the Day. Drugs in Chronic Diseases. The Complex Conditions of Irritable Nerve Centers. Directions for Treatment of Neurasthenia. Sciatica.

WE will take *neuritis* first, for it is short. It is the inflammation of a nerve and is attended by pain and tenderness over the affected nerve trunk, and by disturbances of sensation, burning, numbness, tingling, tearing, motor paralysis, wasting of the muscles supplied by the inflamed nerve, and disappearance of the reflexes. The effect upon the patient largely depends upon the location and number of nerves affected, and this disease can be but a temporary though sharp skirmish, or one of the most protracted and cruel sieges through which man born to trouble can endure.

In the ordinary (simple) case the first pathologic change is hyperæmia and congestion, soon followed by exudation into the nerve-sheath and connective-tissue, and it is the swelling pressure of the increasing inflammatory proliferation and exudate against the inelastic environment that causes the intense tenderness and pain. Recovery to permit restored function must take place by absorption of the exudate before the nerve-elements undergo granular degeneration.

The above central facts point to the principle of effective treatment and show how futile must be the routine prescriptions of works on Practice, save for the pain relieving hypodermic of morphine—a hazardous resort in any long lasting agony save when it is the comforting alternative of an incurable state.

Rest, time, blistering, the cautery, and eliminants are the most heroic recommendations of medical writers, but these reach the disease with an indirect hand and seize it with a feeble grasp. There is but one remedy, usable from the first, penetrating to the seat of trouble, seizing the conditions with commanding force and calling a halt to the pathologic change. This great remedy is the long, thick, muscle-contracting, pain-obtunding, congestion-combating, exudation-absorbing, nutrition-restoring, counter-irritant electric *spark*.

With the high frequency current adjusted to produce the thickest disruptive discharge from the largest ball electrode, apply single thick thumping sparks slowly, with intermissions, but persistently, over the course of the affected nerve trunk and on each point of tenderness until the greatest possible relief is obtained. Do not attack the tissues with a thin, stinging and stabbing spark, for such a dosage will make the suffering worse instead of better.

After the action of the proper spark still further benefit may be obtained in most stages and with most cases by the application of a counter-irritant spray or frictional discharge. In every case there is a period when this is aggravating instead of comforting and a single test of its action can determine whether it is the stage to omit or to use it. After the acute crisis of inflammation is passed it is always indicated.

Treatment should be repeated daily, and twice daily if possible, in the recent activity of inflammation. When the conditions are under control and resolution is in progress a daily treatment, and later every second day, and once a week at the end, will bring the case to the quickest and best possible finish.

NEURALGIA.—This term is applied to the functional pains of nerves which spring from a focus of irritation and depraved nutrition without the inflammatory changes of neuritis. Varieties are named according to the location of the part affected, and any sensory nerve from the top of the

head to the tip of the toe can express this form of pain. It is the vice of nerves of sensation.

Treatment.—High frequency treatment is simple and effective, and the keynote is sedation. Follow this with built up metabolism and the patient will be cured of the neuralgia.

With the glass vacuum electrode adjust the current to a sedative tonic gentleness of action and apply it slowly along the course of the affected nerve, especially acting upon all points of tenderness that can be discovered and on the tissues which give the chief local expression to the pain. Stop the application when complete comfort is attained. Repeat as needed.

To this local alterative improvement add a general tonic application to the entire spine with the same electrode, and this may be usefully alternated with general electrification by the condensation method. Supplement these curative measures and hasten their benefits by the support of internal remedies indicated by the constitutional condition, which is usually anæmic, or malarial, or rheumatic, or gouty, or cachectic in some way.

The neuralgic nerve is a *semi-starved* or an irritated nerve, and the twin problems are to feed it properly and allay the irritation which is usually some waste-product toxin of a deranged metabolism.

Electricity is the positive antidote if treatment is suited to the case. Drug treatment of neuralgia is so difficult of curative action that it has degenerated almost wholly into the dangerous resort to anodynes for palliation only, leaving the patient to drift on the down grade into more and more susceptible conditions and greater frequency of attacks.

NEURASTHENIA.—This is the “Americanitis” of the day. Almost all save the stolid plodders of our nation have a little of it, and the majority of active intellectual workers have too much. At some stage of life in sickness or in health most of us are neurasthenic until conditions change or we outgrow it.

Here again the routine recommendations of medical

teaching become farcical in the light of practical experience in the treatment of this state.

The truth is that age-long traditions of medicinal therapy so fill the mind of both profession and public that the vaguest drug prescription is accepted as the proper thing without any questioning whatever of its doubtful action. With either blind confidence or established habit the drug mixture is taken, and despite lack of benefit and continued illness no blame attaches to the drugs contained in it. Their use in thousands of other cases goes unfalteringly on.

In acute and self-limited diseases drugs are keen weapons and often marvelously helpful to the patient, but in chronic and progressive diseases the reverse is too often the case. Lest some should think we are unwarranted in statements that the actions of selected electro-therapy reach chronic conditions more definitely and more curatively than drugs we suggest that any four of the standard text-books on Medical Practice be *examined*.

Make careful note of the pathology to be reached and altered by treatment, and then make careful note of the drugs advised, their actions, and the very general and small usefulness claimed for the majority of drugs outside of palliatives for the relief (but not cure of the cause) of pain.

A search of this kind with the attention fixed upon discovering the rightful place of drugs in chronic diseases will dismay those who have looked to them as the only remedies and over their curative actions have flung the mantle of unsupported imagination. Next examine the actual results of practice with these remedies, for which text-books *scarcely make any curative claims at all* in the treatment of the diseases we are considering. Symptomatic benefits or palliation may be expected; but of restoration to health, what physician can point to many illustrations?

Indeed, the issue is to a great extent dodged by those who wrongly feel the bias of the partisan instead of the open-minded attitude of pure science. Recently a medical society

held its annual meeting in New York city and the address of the incoming president contained the following remark:

“In looking over the pages of the journal of the great representative body of medical men of America, one is struck with the dearth of *remedial* measures. Hygiene, preventive medicine, pathological findings, bacteriology, etiology, and diagnosis are all great and essential studies; but the sick man asks with reason, “*What are you going to do for me?*”

Despite the limitations of our present skill in directing the great resources of physical agents to curative ends it is the testimony of daily experience that the results of their skilled use in medical practice far outrun in value the lame reliance upon drugs. Of this there is no more question than that water, foods, sleep, exercise, and change of scene are helpful to health and often tonic to invalids. The science of healing is not so surfeited with curative agents that it needs ignore its best and permit the continued rejection of electricity, the chief of nature's own dependencies.

Neurasthenia is variously called nervous debility and nervous prostration. It is defined as “depression due to the exhaustion of nerve-energy.” The name has been given for forty years to a group of symptoms resulting from some functional disorder of the nervous system with severe depression of the vital forces. It is usually due to prolonged and excessive expenditure of energy, and is marked by tendency to fatigue on slight cause, lack of energy and power of sustained work, pains of vague character, impaired memory, insomnia, and the common protests of the alimentary canal against neglect, loss of appetite, constipation, etc. It may be a general state of the body or limited to a local expression—the brain, the solar plexus, the sexual organs, etc. One of the most constant accompaniments is an irritable spine.

It need not reach its maximum stage to be a nuisance. It more generally exists in a minor degree. Probably five

millions of men and women, including girls and boys advancing from puberty, are neurasthenic this side of St. Louis. To its enormous disadvantage, genius is neurasthenic, and if it were not so, or if genius sought proper treatment, its works would be better balanced.

The important distinction is made that while neurasthenia is not a disease yet the individual who has it is sick. The consequences of neglect and the fateful downward drift of health may react so injuriously upon the affairs of the patient and his or her fortunes that treatment is as imperative and as urgent as water upon a burning house. Not too far in the future we see dimly outlined insanity, physical wreckage, hypochondria, suicide and the asylum beckoning to many cases that defer treatment until too late.

With more vagaries than any other disease except hysteria the most constant and marked stigmata of neurasthenia are: Feeling of pressure on the head; inability to concentrate the faculties; disturbance of sleep; pain in the back; sense of weakness; too extreme or too easy fatigue; dyspepsia; sexual disorders; mental poise no longer controlled by the higher centres; over-work almost before actual work is begun; etc. The nervous system is on edge with an exaggerated irritability which finds the patient constantly inviting fatigue by excess of eagerness yet unable to work moderately and to rest.

Advice to these cases, and especially the injunctions, "go slow" and "don't worry," are as useful as Canute's broom to stay the waves, but not more so.

The best treatment is *early* treatment. An ounce of precaution then will be worth a hundred dollar doctors' bill at some later stage after the harm is done. The chain of treatment in an advanced case must be combined of several links, of which the decisive and central link is an electric current. Without the sedative-tonic-restorative-nutrition-promoting actions of electricity the curative actions of all other factors in treatment become like a tire with the air out. They need the stimulus of electricity to make them *go*.

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Treatment.—Investigate causes of the condition, environment, habits, diet, secretions, excretions, and personal hygiene of the given patient and give the practical guidance necessary to improve upon faulty management.

Prescribe any internal medication that can be made to co-operate with benefit. See what can be done in the way of relief from wearing cares, and to secure the rest that is auxiliary to treatment. The assistance of the patient is as necessary to recovery as any portion of the medical therapy. And having done these things add to them the efficient resources of high efficiency currents.

The indications are for both local and general *alteration and improvement of metabolism*. General electrification by auto-condensation treatment may be employed as a beginning, or in alternation with other methods during the course of the restoration to health, but the most forcible and direct impressions upon the nerve cells and internal exchanges of metabolism will be made by making general administrations out of extended local applications. The spinal cord contains the chief nerve centres which are in need of help.

Place the patient comfortably recumbent on the operating table or couch, with the full length of the spine exposed. Under the solar plexus place a sponge covered pad electrode the size of the hand, wet in hot water and squeezed till only damp. Connect this with the grounded terminal of the high frequency current. Have the skin well dried with toilet powder to create the necessary resistance. Select the body glass vacuum electrode and connect to the apparatus. Warm the bulb, cut out the current, apply the bulb to the dorsal spine, and gently increase the dosage of current from zero up to an intensity which causes the patient to report an agreeable sensation of moderate warmth. This will be the sedative-tonic dose.

Now promenade the electrode over each region of the spine, especially removing each tender point that can be found, and making deep action wherever pain has been.

Produce the fullest possible sedative-tonic effects on all the centres from the upper dorsal region to the cerebrum, especially on the medulla and the upper ganglia of sympathetics. The internal work that this administration will do may be ascertained by careful reading of our chapters on physiologic actions. Not a single nerve will escape the influence and benefit of this current.

The tissues of the lower spine are next in importance. Passing the electrode downward to the lumbar region increase the current until its stimulus is at the tonic point. Move the electrode up and down to the tip of coccyx, across the lumbar muscles, and now treat each side of the back as far as the position will permit. Linger over each kidney a moment.

Next, have the patient turn over, place the pad electrode under the back, and apply the sedative-tonic treatment to the chest while deep inspirations and expirations are made for an alterative stimulus to the lungs. Make the same application next to the region of the abdomen to send stimuli to the solar plexus and the vasomotors and secreting cells of the alimentary canal. Treat the region of the liver.

With female patients now pass the electrode to the pelvic region and make deep action through each ovary, and especially remove pains if any exist.

Attend to all special symptoms reported by the patient. If headaches are frequent include the forehead or seat of the pain in the treatment. If any of the muscles or joints are rheumatic, treat them accordingly. In fact, make the most complete work possible out of each seance. A few final inhalations of ozone will finish the tonic effects.

This thorough work cannot be well done and indifferently done—tossed off in ten minutes. If the patient is important enough to treat at all it is important to take the time and care required to make health certain. Twenty minutes at least should be allowed for these treatments and after them the patient should rest and if possible to obtain a nap should do so.

Next in value to the patient after *thorough* treatment will be *frequent* treatment. When the intervals between the administrations of electricity are so long that the benefit of the last is lost before the next one is obtained the results will disappoint. Until the gain warrants a longer interval the early treatments should be given every day, and if the patient is treated at home or under circumstances that make a treatment night and morning possible this will be still better and the gain will be faster.

SCIATICA.—This great example of neuralgia, or neuritis, or both, requires individual consideration. As the greatest nerve in the body in respect to size it is the seat of some of the most excruciating pains—to which are attributed a variety of causes. Some hold that sciatica is always a *neuritis*. Some of the latest surgical writers hold that sciatica must be attributed to *peri-neuritis*, or *adhesions* resulting therefrom, and the cure is then an operation to detach the adhesions.

The present author is of the opinion that the sciatic nerve can be the seat of purely neuralgic pains, of pains resulting from inflammatory action (neuritis or peri-neuritis) and in addition, the latter pains can be made more resistant to treatment by the growth of adhesions as sequelæ to peri-neuritis. Certainly, all stages and degrees of "sciatica" are met with in our practice and we must admit a reasonable gradation in their causes. Besides these are tumors and certain surgical conditions within the pelvis which we do not consider here.

It is very necessary to form the clinical picture of gradations of cause, ranging from functional neuralgia to connective tissue adhesions, as the results of treatment cannot be the same in the most difficult and in the simple and recent case. In the latter condition the pain may be as severe but the cause behind it is functional (or has no advanced alterations of tissue) and we may remove the pain and the cause by a few electrical treatments, and within a week. But in the case of adhesions the pain may only

slowly yield to electrical treatment and it may take two or three months to effect an entire cure—or the pain may resist all measures of relief until the nerve is liberated by the surgeon. But short of this need, the supreme remedy for sciatica is to be found in high potential currents of electricity.

Treatment.—The principles of curative treatment combine heat, counter-irritation, nutritional alteration, and the contractions of muscle fibres. All these are readily applied by means of high frequency currents, but not by any drug remedies.

Posture the affected leg in such ways as to excite the pain in all the different ways in which it can be aggravated by movement or position or strain.

In each position apply a hot counter-irritant discharge from the glass vacuum electrode made sufficiently intense by the dry resistance of cloth, as taught in Chapter XIV. With firm contact rub the electrode up and down the affected part of the nerve trunk, regulating rapidity of movement according to intensity of action. With a heavy current and high resistance a movement that is too slow will cause discomfort without need, while too fast a movement will fail to give the current time to act. Experience and a few tests on yourself speedily teaches this technic.

Do not attempt to accomplish the entire treatment with one continuous application but after a few rubs of the electrode, at the instant the tissues of the patient begin to resent the intensity of heat, withdraw the electrode for a moment. After the patient rests repeat the application, and in this way persist until as much of the pain is relieved as can be removed by this dosage.

Next follow the counter-irritation with the muscle-contracting spark. Posture as before and apply single, thick, dull spark-blows along the course of the nerve where pain is felt and for some distance beyond. With attention to the great art of "letting up" at the right intervals to allow the tissues a respite and also to take account of stock and



PLATE XIX.—Illustrating the Author's correct principle of muscle-posturing in the treatment of sciatica. The figure at the left shows the affected leg putting the nerve on stretch with foot on chair, weight thrown on leg, and pain aggravated by the position. Treat the course of the nerve trunk until pain in this posture ceases. Then have the patient squat and throw most of his weight on the affected leg. Treat, rest, and squat, and treat again, until pain is removed. In figure at right the affected leg is thrown forcibly forward, making a still different tension of the muscle-fibres and altering their compression of the swollen nerve-trunk. Apply your counter-irritant and muscle-contracting current until pain is no longer set up by any posture. Repeat as needed until relief is lasting.

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ascertain how much pain is still left, persist in treatment until the patient can walk and take all positions with normal comfort—or you find out that it is impossible to remove all the pain at the given seance.

If the pain is recent, sharp, and returns quickly after the first treatment has abated it, repeat treatment twice daily if possible, and at least once a day, until relief lasts more than this interval. Continue treatment daily and then every second day until relief becomes permanent.

In an ordinary recent case improvement should be rapid and entire relief should be obtained in from six to ten treatments. In a more chronic case the evidence of benefit should be just as quickly obtained but full and lasting relief will take much longer—ordinarily from three to six weeks.

Very chronic cases, lasting for years, but curable, yield in practice to two or three months' treatment. Now and then a case may linger out a longer time but this is rare unless complications increase the difficulties of relief.

Occasionally a case, either recent or old, may represent a condition that the actions of counter-irritation and muscle-contraction cannot affect and the experienced physician soon learns to judge from the results of his first tests of current whether high frequency can restore the tissues to normal or not. The penetrating radiations of light from a 500 cp lamp will carry into the tissues the action required to correct some of these rather infrequent cases that resist the current.

If resistance to treatment and the most skilled diagnosis indicate that adhesions prevent recovery until the nerve is liberated, then an operation is advised. But the operation is not all the "cure." It is only the *beginning* of it. It simply precedes the curative treatment by the high frequency methods described above. The operation fits the nerve to respond to the action of the current, and recovery that was impossible before is now rapid.

In other cases surgery may be the cause of the sciatica

and almost the only refractory cases we had for a number of years had been operated on and sciatica afterwards developed. Rare cases occur also which cannot be explained and which yield to no form of curative treatment—pitiful and trying to all.

CHAPTER XXI

SOME DISORDERS OF THE DIGESTIVE TRACT

Atonic and Nervous Dyspepsias. Atonic Dilatation of the Stomach. Constipation and Diarrhoea. Torpid Liver and Faulty Bile Circulation. Visceral Neuralgias. Remarks on Special Technic and Rectal Conditions.

WRITERS on Practice classify five dyspepsias, but as digestion is dependent on regular co-ordination of the nervous stimuli to secreting cells, glands, motor centres, and the vasomotors, none of the different varieties can get far away from a nervous origin and nervous remedy. This is why an electric nerve stimulus can be made to help restore the normal functionation.

Among the chief causative factors of *atonic* dyspepsia are "nervous depression from worry and fatigue," so it is useless to separate these two varieties in considering electrical treatment. In well-developed cases they are marked by drowsiness after meals and insomnia at night, by defective memory and lessened mental vigor, by headache and constipation, a sense of distention and weight in the epigastrium, an excess of urates and oxalates in the urine, and by various other cardiac, digestive and vasomotor disturbances.

A man given to these evils (and active business men are among the most numerous victims) should train himself to quiet down a little before he eats and to eat with reasonable deliberation. No rules of diet are worth pursuing. Eat with sensible absence of haste, seek proper treatment, and then eat like a well man without regard to "rules for the dyspeptic."

Treatment.—Apply a strong tonic dosage of high fre-

quency current to the region over the solar plexus with the vacuum electrode. Move the action of the current over the stomach and entire intestinal tract, and finish with the region of the liver. Then have the patient inhale the ozone discharge for a couple of moments. Reverse the patient and apply the same dosage to the course of the spine. Repeat daily until improved and then every second day until well.

ATONIC DILATATION OF THE STOMACH.—Apply a strongly counter-irritant dosage of high frequency current through the area over the stomach by the glass vacuum electrode. Repeat daily or every second day. Or, apply a strong spray to the stomach with a pad electrode on the dorsal spine behind the solar plexus.

See Chapter VIII for account of successful treatment of seventeen cases, in all of which the stomach resumed its normal position. Treatments ranged from ten to twenty in number and in fifteen of the cases normal digestion was restored, perhaps the most remarkable series of cases on record.

If the questioning physician will take the same electrode and a milder stimulating dosage of high frequency current and apply it to the relaxed nipple of a flabby breast he may have the evidence of his own eyes of the stimulus upon vasomotors and motor nerves.

CONSTIPATION.—In simple deficiency of secretion and diminished peristalsis the application of a tonic dosage of high frequency current over the entire region of the stomach, abdomen and liver, especially concentrating the current through the solar plexus, is often satisfactory. We have had patients with very thinly covered intestines state that they were “almost conscious of the increase of secretion” stimulated by this means, even independently of better action of the bowels. We once had a patient who declared that he could actually “feel the bile running out of his gall-bladder.” And he was a physician himself.

With the internal organs thickly covered with fat and the

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kind of abdomen known as a "corporation" this simplest method is far less efficient.

In the more obstinate constipations the following methods will be found to possess greater energy of action: Substitute for the vacuum electrode a sponge covered hand electrode, with a pad electrode placed under the lumbosacral region and connected with the grounded terminal. Select the lower potential interrupted current which will set up waves of contractions and with this "faradic" method go over the same regions with deep muscle stimulation.

Or, place the patient face downward on the operating table and select a round or "rectal" glass vacuum electrode of a size to suit the given case. Lubricate it and insert in the rectum, with the usual pad electrode under the solar plexus and connected with the grounded terminal of the high frequency current.

Regulate the dosage to the point of tolerance. If irritation occurs, or the sense of heat becomes marked, cut out the current for a moment. Then resume as before. Make the application equal ten minutes of treatment. Repeat daily till improved and then every second day.

No matter which of these methods is employed the body vacuum electrode should be applied with a strong stimulating dosage to the region of the liver, the solar plexus, and the entire length of the spinal cord, in which are the centres that control the nervous mechanism of secretion, peristalsis, and defecation. Personal habits with regular attempt to move the bowels at a definite time each day, and a rational diet must help this work or lasting benefit is about as possible as to get fat on skimmed milk. Chapter X has an interesting account of cases.

DIARRHŒA.—As a symptom of an underlying condition the results of applying a local stimulus to the secretory and nervous mechanism of the alimentary canal in an effort to regulate the deranged functions to normal will depend upon the absence of organic lesions and foci of irritation which cannot be removed. But after clearing the bowels of such

undigested food and causes of irritation as can be eliminated, the tonic and restorative action of the high frequency current will do much to establish physiologic action.

After preliminary treatment of the canal or being assured that no foreign matter remains in it, apply a tonic dosage of high frequency current over the regions of the solar plexus, stomach, intestines, liver, and spinal nerve centres.

This same "toning" effect upon the depressed and wearily struggling energies of the splanchnics should be of considerable tonic and even healing benefit in the relaxed state of typhoid fever. As the action is physiological and the reverse of a drug "astringent" it can produce only benefit without harm. This should also be true in all diseases with marked depression of the sympathetics.

TORPID LIVER AND FAULTY BILE CIRCULATION.—The work of the liver is complex, as has been shown elsewhere, and the bile has a pair of channels for excretion and circulation. Part of the bile, especially the important biliary salts, should maintain an "hepatic-intestinal circulation" and if this is blocked or part of the bile is side-tracked into the blood-circulation the eyes get yellow and the skin takes on the tinge of jaundice. Stools become gray and chalky, and much trouble ensues; or, in minor degrees we have the mere lethargy, malaise, and hebetudinous state of the "bilious."

The drug cholagogue is palliative and our first resort, but exerts no curative action upon the tendency of functional derangement. If the liver proposes to remain deranged laxatives will not reform it. In time they will tire it.

When the best of inducements to reform have been offered the liver by the gentle coaxings of calomel in small doses and a little nux to help it, and the organ does not meet our expectations we should add the stimulus of the high frequency current.

Apply a strong tonic dosage through the body vacuum electrode to the region over the liver and the gall-bladder (here making deep pressure). Next, over the solar plexus,

and entire stomach and epigastrium. Then reverse the electrodes and tone up the spinal centres.

By judicious co-operation of the patient in eating, by the assisting help of gentle cholagogues at first, and by persistence in the high frequency stimulus to nerve, cell, and vasomotor functions, as much improvement as may be possible will be obtained.

VISCERAL NEURALGIAS.—From gastralgia and colic to the ovaries attacks of neuralgic pain sometimes affect some of the internal organs—the viscera of the body. When the pain is purely neuralgic and without organic lesion the sovereign remedy is an electric sedative and nutritional tonic.

For local treatment of the irritable nerves of the affected organ apply a sedative-tonic dose of high frequency current with deep pressure upon the glass vacuum electrode to get the tip of the tube as close to the seat of pain as possible. Maintain the action of the current until pain ceases. Repeat daily while pain is severe, and every second day after improvement enables the interval to be lengthened.

For general systemic action to improve nutritive metabolism apply the same current with a stimulating dose to the spinal centres and to the regions of the solar plexus and liver.

Even in attacks of gall-stone colic this method may be employed, sometimes with entire relief from further formation of inspissated bile or the smaller concretions. In the presence of an old and hard calculus electricity might do little, but in all cases it can well be added to other measures for the sake of its quieting effect upon irritation and its valuable influence upon the nerve centres, vasomotors and secretions.

Remarks.—Some specialists utilize the greatly increased conductivity of the moist mucous tissues of the alimentary canal and avoid the resistance of the skin by connecting one terminal of the current with a metallic electrode held in the mouth (there being no sensation), and to the other terminal connect a vacuum electrode inserted in the rectum.

Not only in nervous dyspepsias but in gastric ulcer, some cases of gastro-intestinal catarrh, and chronic entero-colitis they report very beneficial results, and the technic has practically no drawbacks. A physician also writes: "In acute inflammation of any part of the digestive tract the direct application of the glass vacuum electrode over the abdomen will often be effective. In appendicitis prior to abscess the vacuum electrode over the site of inflammation and a metallic electrode in the rectum with a sedative current passing between will often abate the attack."

The results and methods of treatment of various rectal conditions, fissure, ulcer, spasm of the sphincter ani, itching of the rectum, and hemorrhoids, have been so fully reported in chapters nine, ten and eleven that we need not give additional directions here.

CHAPTER XXII

HEADACHES

The Three Groups of Head Pains. Nature of Headache and Relation to Stomach Disturbances. The Uric Acid and Bilious Headache of Migraine. Directions for Immediate Relief and Permanent Curative Improvement. The Advantages of Tonic Electrical Treatment over Injurious Drug Depressants.

HAPPY the man, thrice happy the woman, who never knows a *headache*. Once the evil of this nagging nuisance was the *hurt* of it, but dry-goods stores' and druggists' counters have given a modern twist to the importance of this symptom by the sale of popular headache powders as common merchandise and oblivious of medical advice. The anæmic victims of habitual and severe headaches resort to "powders" as the thirsty resort to drink. Coal tar has robbed morphine of its deadly pre-eminence in popularity but the substitution has not been in the nature of a tonic. The frequent and peristent use of most of the anodyne headache powders now swallowed by the million is slow suicide. In a number of reported cases the suicide has been rather swift.

Therefore, a chapter devoted to the nature and beneficial treatment of aches in the head is an urgent need of this book. No other form of ache is so common, so well-nigh universal. At some time of life (if not before) we all seem destined to have a headache. And what is it?

Some head pains are outside the skull, and these may be neuralgic, rheumatic, or of the bone or periosteum. Other head pains arise within the cranium and this group includes tumors, meningitis, abscess, syphilis, arterio-sclerosis, and disease of the inner table of the skull and membrane. This

second group does not fall under the ordinary classification of headache.

The third group embraces the *functional* headaches of notorious prevalence in America, and consists of eight varieties: reflex, toxic, neurasthenic, hysterical, anæmic, hyperæmic, digestive and the "sick headache" called migraine, which is the worst.

The true headache is "an intra-cranial pain caused chiefly by irritation of endings of the fifth pair of nerves (the great sensitive trifacial) and partly also by irritation of the branches within the skull of the sympathetic and pneumogastrics, the nerves which connect the digestive organs with the head."

In practically every disease of the stomach headache is a common symptom, and in almost every headache some degree of digestive disturbance is associated. In a few cases the headache may cause the gastric derangement, or depress the gastric functions. In a number of cases the stomach is the direct cause of the headache. But in the main it is held by diagnosticians that both the distress in the head and the distress in the stomach result from a common cause, toxic or reflex or irritative.

Some of the headaches resulting from causes in the digestive tract are *toxic*, from fermentation products of decomposed foods. Others are reflex from some intestinal focus. Some may be due to diversion of blood into the digestive organs after eating, for circulatory changes in the cranium relieve some headaches and cause others.

But a still more important connection between headaches and stomach is the insidious lessening of tissue-resistance when nutrition is reduced. Then anæmia, neurasthenia and kindred harvests of gastric disturbance cause the patient to respond to sensory *stimuli* which in health would be unfelt, and headaches, backaches, neuralgias, etc., cry out from the irritable nerves.

Conversely, this fact is a hint for treatment. Oculists find that *almost* all headaches spring from *eye-strain*. It is

their favorite cause. But sometimes the headache persists despite the spectacle cure. We look at the patient and find him (or her) ill-nourished, anæmic, or overworked, and not till we correct these conditions does the head grow into comfort. The nose specialist attributes a headache—a lot of them—to nasal obstructions and removes the last without removing the first, until we increase the red blood-corpuscles and put the impaired metabolism on a sound basis. To the gynecologist the uterus and ovaries misbehave very often and send pains to the head, but pelvic repair may fail to improve the headaches until we raise the hæmoglobin, nourish the impoverished nerve centres, and build up the normal tone of tissue-resistance.

Hysterical headaches and hysterical digestive disturbances go hand in hand or may alternate, resulting from a common cause. The treatment of neuralgic, rheumatic, gouty, syphilitic, and uric acid headaches and the headaches of arterio-sclerosis, all amenable to high frequency currents, is very successful but *migraine* can balk at every remedy till it runs its course. We will refer to it further in a moment.

In chronic gastritis headaches are a common symptom, arising, perhaps, reflexly from irritations of the stomach wall, or by the absorption of toxic materials from imperfect digestion; or are lent intensity and promoted in frequency by the diminishing *resistance* of tissues and nerve cells.

In dilatation of the stomach and reduced motor power of the organ the retarded mass of contents forms poisonous products for absorption which hurt the brain cells and make them ache.

Displacements of the stomach, kidney, and uterus go hand in hand with neurasthenia and headache. In certain cases the patient may have stomach-ache, or back-ache, or neck-ache, or head-ache, or a variety of neuralgias; and if we treat the faulty condition first and then build up metabolism to par we can finally stop the aches and neuralgias permanently.

Migraine is the bilious and sick headache of common parlance. Instead of being caused, as generally supposed, by hepatic or gastric disturbance it is now regarded as a cortical nerve storm with gastric symptoms, the furious enemy of assault being none other than our leading product of sub-oxidation—uric acid, or its near relative.

According to this view it is easy to see how the toxic agent in the blood may at the same time irritate the cerebral cortex (producing headache), the cervical sympathetic ganglion (producing vaso-motor spasm and dilatation), and the pneumogastric centre (producing the stomach symptoms), and it is conceivable that the poison may be directly excreted into the stomach, as in uræmic conditions, with direct action.

Mangelsdorf offers a new observation to the effect that in every case of migraine there occurs an acute and well-marked dilatation of the stomach, and these repeated acute dilatations lead in time to a permanent gastric atony. He explains these effects as due to centrally acting causes and believes that migraine patients receive great relief from the correction of the atony and the restoration of the muscular tone of the stomach walls. This can be done by electricity. See Chapter VIII for account of clinical cases.

In migraine the secretion of gastric juice is reduced, but headaches are frequently associated with an opposite condition of excessive gastric secretion, and especially of an excess of acidity. Restoring the secretion to normal is a relief to the head symptoms.

Treatment of headaches. We have two problems to work out: immediate relief and permanent cure. For immediate relief the action of electricity is physiologic and leaves the head and body freed from pain with a tonic benefit and with none of the depressing or injurious by-effects of large doses of anodynes. It also acts quickly, in favorable cases giving entire and long lasting relief in a few minutes—rarely more than ten, often within five, and in many instances clearing the head of all pain in from five seconds to



PLATE XX.—Illustrating sedative application to forehead in case of frontal headache or neuralgia. Regulate to mild dosage and promenade the electrode gently over the surface until the pain is relieved. Repeat as needed. When pain extends to the vertex or back of head, treat in the same manner through the hair, first, in the case of a woman, letting the hair down so as to reduce the resistance as required. The action of proper dosage is exceedingly comforting and agreeable. Supplement the local treatment by general treatment to correct the cause of the headache.

a single minute. But it cannot do this if the exciting cause of the present headache is active and not possible to get under control by the methods employed.

If the patient feels a sense of relief from warm applications treat the area of headache with a warm sedative high potential spray, or by a warming sedative dosage with the glass vacuum electrode.

If the relief is from cold applications apply the cool breeze of the opposite pole with all resistance removed from the bare skin and seat of pain.

If the headache is congestive make a counter-irritant application to the back of the head and upper spinal centres. In a case of recurrent headaches of a dull character, with evidently sluggish venous circulation in the head we have induced jugular drainage and freed the head from pain and roused it to a sense of clear relief *instantly* by one swift muscle-contracting spark on each jugular in the neck.

Sedative-tonic sprays or vacuum electrode to the region of pain are effective in rheumatic, syphilitic, and osteal headaches.

In neurasthenias and functional headaches, if the patient is anæmic and the face pale apply a stimulating but pain-relieving current. If the face is flushed apply counter-irritation to the spine and a sedative spray to the seat of headache. If the scalp is sore and tender a sedative spray will comfort it and remove all the soreness.

In the treatment of headaches do not use a fixed electrode and a persisting spray or any other fixed discharge upon the head. Use an electrode managed by the *hand*, and manage it so that the desired effect will be produced—and no other. A fixed spray on an aching vertex can be maddening, while the same current guided by the hand can be made the Balm of Gilead. Management of the resistance of hair is required. Some patients have little and some have medium and others have thick hair. All these conditions affect the action and dosage of current.

The general condition, either as the cause or as the ac-

companionment of the headache should be treated according to directions given under the different headings in this book. Most cases need general as well as local treatment. The improvement of general metabolism is important. This was well illustrated by the following :

Mrs. H., aged thirty, brought her baby for treatment. She held the infant while it received a general high potential charge for ten minutes, three times a week. She simply held the child and shared in the general electrification, but had not reported any need of treatment and was not known to be subject to headaches until after the lapse of a month. She then reported to the writer that she had had habitual and severe headaches all her life since the age of nine, remembering very few days when she was free from them, but she noticed that her head was now free from ache more than half the time and always felt comfortable after treatment and for the day following each sitting with her baby.

Refer to our chapter on digestive disorders and note the treatment of atonic dilatation of the stomach and apply it to the curative treatment of migraine, between attacks. In toxic conditions aim also to promote elimination, and the efficacy of a proper electric light cabinet bath should not be forgotten as an aid to high frequency currents.

Sometimes a headache that only partly yields to treatment will entirely pass away in a short walk in the open air afterwards. By noting the behavior of an habitual headache in a given case we may nearly always interpret the indications and work out a successful treatment in a reasonable time.

CHAPTER XXIII

DENTAL CONDITIONS AND THEIR TREATMENT

The Services of High Frequency Currents to the Dentist and His Patients. An Indispensable Remedy in the Modern Dental Office. Directions for Treatment. Toothache. Neuralgias. Sore and Bruised Gums. Inflammation. Ulceration of the Gums. Gangrene. Alveolar Abscess (Ulcerated Tooth). Sensitiveness of Teeth. Riggs's Disease of the Gums. Dislocations and Fractures of the Jaw.

THE general prevalence of teeth in the community and their intimate connection with the sensitive trifacial nerve, the most sensitive nerve in the body, affords the dentist in his special field a number of opportunities to employ high frequency currents. The simplest apparatus will suffice for the limited range of technique required, and once installed in his office (and its worth demonstrated) no master of the dental art would thereafter deprive his clients of the benefits and comforts of its resources.

It will be a short story to state the indications for this remedy and describe the ways to use it. We may begin with that potent contributor to the business of the dentist, in the case of many people the first and only mainspring of impetus sufficiently powerful to send them to the dreaded chair:

TOOTHACHE.—This is not the scientific name for it but both dentists and their patients will know what we mean, and *odontalgia* is far less expressive.

The tooth does not ache, it is the nerve in the tooth. Numb it with a pain obtunder or fill the cavity secundum artem, or in desperation pull the tooth out. Any of these procedures may in the end stop the ache: but what impatient patient with a jumping tooth ever fails to want it

stopped in the *beginning*. Stop the pain before you touch it, is the universal desire of the public. Can it be done? With ease. And without touching the tooth and without asking the patient to open his mouth.

Hand the sufferer the glass vacuum electrode, tell him to push it hard against the jumping nerve, switch in the current and go on with your interrupted work. In a very few minutes the toothache will be a thing of the past, and the patient is then usually in a more receptive mood toward suggestions for permanent repair.

This relief is absolutely *physiologic*. The nerve has not been dulled with an anodyne. There is no bad taste left in the mouth. Nature herself, prompted by the stimulus of the current, has abolished the fretting cry of the nerve. In cases of caries, with cavities as large as the tooth (the merest shell remaining), we have over and over again seen relief of this kind last for months with no other attention except the one electrical sedation. This neglect has been against our advice but the duration of the relief showed what electricity could do.

NEURALGIA.—This functional disturbance, the pain being the symptom of an irritation not located, may have any of several conditions back of the irritable focus; but when not of a surgical nature, such as a tumor pressing on the nerve, we may abandon "antiperiodics," the score of recommended and uncertain drugs, and even the classical "removal of the terminal filaments within the bony canal," and need scarcely consider at all the "removal of the Gasserian ganglion within the skull."

Text books speak of these choice alternatives of treatment, from quinine and arsenic to the operation of "last resort," but when we have true neuralgia to treat there is but one remedy to consider and to use. To prescribe up-building remedies for associated anæmia or cachexias is sound practice but for the neuralgia *per se* prescribe the sedative-tonic action of the high frequency current.

Apply the usual glass vacuum electrode to the seat of

pain until the sedative effect of the current has given entire relief. Then repeat over any tender point that can be found, and when that is done finish by soothing the nerve at its emergence from the cranium.

Not only is this treatment an efficient immediate palliation of most trying pains, but it is the first of curative remedies—more certainly curative than all the blisters, torments and drugs of twenty centuries of empiricism. If properly administered electricity does not relieve and gradually cure a case of nerve pain that has been diagnosed as “neuralgia,” the failure is evidence of a mistaken diagnosis and the supposed neuralgia is something else.

SORE AND BRUISED GUMS.—Traumatism of the gums not only impairs pleasure in eating but opens avenues for infection and inflammation. In some half-dozen instances patients of mine have happened to come directly to my office for other treatment directly after leaving their dentist. Sometimes the process of filling a number of teeth has produced a general ache. Sometimes one, two, or more teeth (in one case six) have been pulled out, leaving the gums in an intensely painful condition. None of these patients had received any local sedative from the dentist but were sent home to let time heal the wounds.

The external application of the high frequency current using a sedative dosage through the glass vacuum electrode, will comfort the bruised nerves, restore the vasomotor tone, remove the local stasis and renew normal circulation through the vessels. No one who has not personally experienced the relief afforded by this simple application could credit the change it makes. It is a physiologic restoration of the normal state, quite different from any anodyne or mouth wash, and the general adoption of such a means of preventing lodgment of germs and needless interference with eating would heighten by a marked per cent the repute of “painless” dentistry.

INFLAMMATION.—The dentist has often to deal with inflammation in all stages. In a narrowly localized zone this

"disturbance of the function of nutrition, characterized by heat, redness, pain, swelling, and alteration of the function of the part affected" should be promptly checked. Hardly any one who has experienced the personal emotions of an ulcerated tooth will disagree with this dictum.

Inflammation begins as an "irritation." In this stage a sedative high frequency current will allay the irritation, if it can be applied to reach the seat of it.

A "hyperæmia" of the blood-vessels is next seen. The vaso-dilators have felt the "irritation" and responded. But a soothing and tone-restoring dosage of high frequency current applied directly through the affected zone will calm the storm at this stage, if the nature of the cause will allow it to be calmed.

The rising activity of the process, if unchecked, now reaches "congestion," and at this stage the same treatment is one of the few sovereign remedies. It is one of the surest, safest, and most easily applied.

If no remedy has been sought thus far the fullness and heat of the throbbing vessels, the swelling and the pain, soon announce that neglected congestion has passed into acute "inflammation." The same control of the vasomotors and the same abatement of irritability will still be effective (in ordinary cases) to combat the fully developed process and quickly restore the function of the part. The absorbents take up the serum, the leucocytes float away, swelling subsides, pain ceases, redness disappears, the local flames of tissue-combustion are put out, and the soothing current bears healing on its wings.

But suppose that either despite some other treatment, or because of non-treatment, or from extreme virulence of septic infection, we have "suppuration" to contend with. When a part is the seat of an abscess and the dental surgeon has cleaned out the pus and fitted the conditions for repair, now comes to the front again the usefulness of high frequency stimulus to healing. Treat the part exactly as before. Repair will be greatly hastened.

ULCERATION OF THE GUMS.—When any ulcer of any tissues shows no tendency to heal, and especially if erosion and sloughing extends, add to simple cleanliness and dressing the germicidal and nutritive energies of a high frequency application. If the ulcerated area can be reached directly by an ozone discharge from the electrode it will dry pus, kill microbes, and disinfect. The healing current then rapidly carries forward the process of restoration of the tissues to normal.

GANGRENE.—If the dentist should meet gangrene he is aware that the preventive treatment consists in maintaining the equilibrium of the circulation, the relief of tension and constriction, and favoring the venous current. Warmth and blood are two prime necessities. High frequency stimuli go far to meet all the physiologic requirements of the tissues in the treatment of a limited area of necrosis. Add it to other measures and the best possible results will be achieved.

ALVEOLAR ABSCESS.—We here speak of this cause of acute suffering (the Ulcerated Tooth of the laity) to present two valuable points in treatment. It appears to be the belief of text-book writers, of most dentists, and of the victim, that in the agony of the long nights and years crowded into hours of torture, there are no resources short of the hypodermic save a hot-water bag, a "hot fig laid on the gum," or a poultice. These are trivial mockeries.

But order three drams of pure chloroform in three ounces of tincture of camphor; anoint the skin with a thin protective coating of cold cream or even plain vaseline; dampen a folded piece of flannel with the chloroform and camphor; lay the flannel on the swollen cheek, and hold it in place with a bandage over the head. If in bed, recline on the affected cheek, with the palm under the counter-irritant compress and pressing it in effective contact. It will speedily create a sense of heat. When this reaches the limit of tolerance insert a finger under the flannel, lift it from the skin and let cool air relieve the tissues. Then replace the

pressure and in this manner coax along the highest bearable intensity of action.

The flannel will soon dry. Wet it again and again, as often as needed. When relief ensues the patient will sleep. Care must be taken during the sometimes prolonged siege to avoid keeping the counter-irritant on too steadily, or the skin will be overtaxed and become so tender that no further help from the application can be had. But with judicious management it outclasses any and all palliative measures until the patient can again open the locked mouth and permit the dentist to take charge. Of the merit of this measure we speak from forty years of personal knowledge and experience.

The second point in relation to such a case is the after-treatment and rapid restoration of the jaw to normal usefulness by a few applications of high frequency current. After the dental evacuation, drainage, and extraction or proper treatment of the tooth, the healing-tonic of the current will do the rest.

SENSITIVENESS OF TEETH.—It often happens that a tooth is morbidly sensitive to heat, or cold, or touch, creating great discomfort with no manifest cause upon which the dentist can work. Sometimes several teeth are affected in this way. It may occur after a filling and at the patient's impatient request for relief the dentist may remove the filling to seek a hidden cause and treat it. Or, the patient may be left to the consoling balm of time and the nerve may gradually regain its lost tone.

With a knowledge of the personal annoyance of this condition, in eating, in cleaning the teeth, in taking hot or cold drinks, even in opening the mouth in cold air if the nerve is sensitive to cold, no discreet dentist will make the removal of this very common complaint a matter of weeks, or days, or more than a few minutes. Many times in five minutes we have transformed the grumblings of this condition into the gratefulness of complete and permanent relief. Why should it not always be done without delay?

Apply the glass vacuum electrode to the skin over the tender tooth, regulate the current to a sedative dosage, gently manipulate the electrode over all the region affected, and continue until tests prove that the morbid sensitiveness has disappeared. One treatment may suffice for this. But if not, then repeat the treatment two or three times until entire comfort is restored. It is the most beautiful of measures to swiftly restore the lost tone of any nerve anywhere we can reach it.

RIGGS'S DISEASE OF THE GUMS.—*Pyorrhoea alveolaris* is pretty nearly the sure accompaniment of neglected teeth and tartar. Between the first red tinging of the tooth-brush when delicate vessels tend to bleed, and the late erosion of gums, absorption of bone and loosening of teeth, an army of people carry with them the slow march of this seldom treated process and scarcely know that it is a formidable, preventable, and curable disease.

Whenever irritable, bleeding and obviously unhealthy gums are discovered in a person's mouth, long before they begin to recede and show pockets of pus, they should be treated, the teeth kept clear of tartar, and always an antiseptic used in cleansing them. But in the early stage people seldom wish to go to the "trouble" of thorough and curative treatment at the hands of a dentist. In the late stage they feel that attempts at "curative" treatment are useless, so finally out come the teeth that reasonable care could have saved. A special set of vacuum electrodes is made to apply treatment directly to the gums.

An efficient and simple treatment can be applied to all cases; curative in the stages prior to destruction of tissue; maintaining an arrest of the process in later stages; or making the best of a bad job when the teeth have loosened and symptomatic relief and an eleventh-hour improvement of nutrition for the reception of store-teeth is all that can be done.

Clean the teeth, prescribe the hygiene of the mouth, give the gums a thorough local treatment to start the patient

on the way to healthy gums and then make daily regular use of the high frequency current in the dose of a tonic-stimulus and alterative of vascular nutrition. Move the vacuum electrode over the external field of the gums slowly for about ten minutes at each application. The repair of nutritive activity will take time and be gradual but the patient cannot spend the time to better advantage.

One recompense of immediate value in the late stage when only palliation can be expected is the prompt relief of all troublesome symptoms. In one of our patients who suffered severe pain keeping her awake all night, the slightest touch causing intense hurt, pressure on chin intolerable, eating impossible, nerves in a wreck and tears the frequent vent of distress, the first application of a high potential current reduced the suffering to almost nothing, abolished all the active pain, and started her nerves on the road to courage. With a few treatments she could eat comfortably, the gums took on the hue of normal circulation and when her teeth were replaced with a manufactured set she blessed the means that had fitted her gums to wear them.

DISLOCATIONS AND FRACTURES OF THE JAW.—These are not without interest to the dentist as the lower jaw especially may suffer from various sorts of traumatism. After the surgical repair is made there still remains the restoration of normal function. Instead of leaving nature to herself and time and in some cases witnessing a slow or even imperfect result let us give nature the helpful assistance of electricity. Use the glass vacuum electrode and a stimulating dosage of high frequency current. Move the bulb in contact with the tissues where sensation is normal but if muscular stiffness is associated with coldness in any part, or sensation is dulled, lift the electrode a half inch and treat the area with warming, energising, counter-irritant frictional sparks. The value of a rapid restoration of function and removal of traces of the injury is sufficiently great to make the neglect of electricity punish the patient for the choice of a non-equipped dentist. And in these days, with

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a lamp socket in almost every dental office and with a pocket instrument so simple that a nurse can use it, there should be no dentist in any town above the smallest obliged to deny his clients the benefits they need. If high frequency currents have become indispensable to the physician they are not less so to the progressive D. D. S.

CHAPTER XXIV

THE ANTIDOTE TO WORRY

The Worrier and His Real Need of Treatment. The Worry-Germ in the Liver. Condensed Advice and Directions for Curative Treatment of Worry.

To the nervous and feeble, the painworn and hard beset victims of circumstance and baleful fortune, tormented out of just relation to the world about them, what use is it to ask, "Why Worry?" or to embellish a book about it. As well tell the pining woman to marry when she has no lover, or direct a man to hoist himself into happiness by the strap of his boots, as to make a medical prescription of the injunction, "don't worry."

Wit has flung many javelins at Worry. A brilliant medicine man has set up the diverting Chinese motto: "The legs of the stork are long; the legs of the duck are short; you cannot make the legs of the stork short or the legs of the duck long," and draws the moral from this that it is useless to worry. But no patient known to us has worried about the legs of storks or ducks for a long time, and we might reply to him: "The frog does not feel a pin when we stick it into him; why do you?" What is pain to a frog? Why feel it?

Alas! the "Don't Worry Club" of theory and picturesque reporters does not exist in practice. Worry is not a matter of will or desire. It is the reflex of oppressed centres in the brain. When waste products of metabolism fail of elimination and poison our higher nerve cells their cry of warning and for relief is worry; we *worry*.

Toxins and mutiny in the liver fret us. We are fretted often without knowing why or where, as the wiggling in-

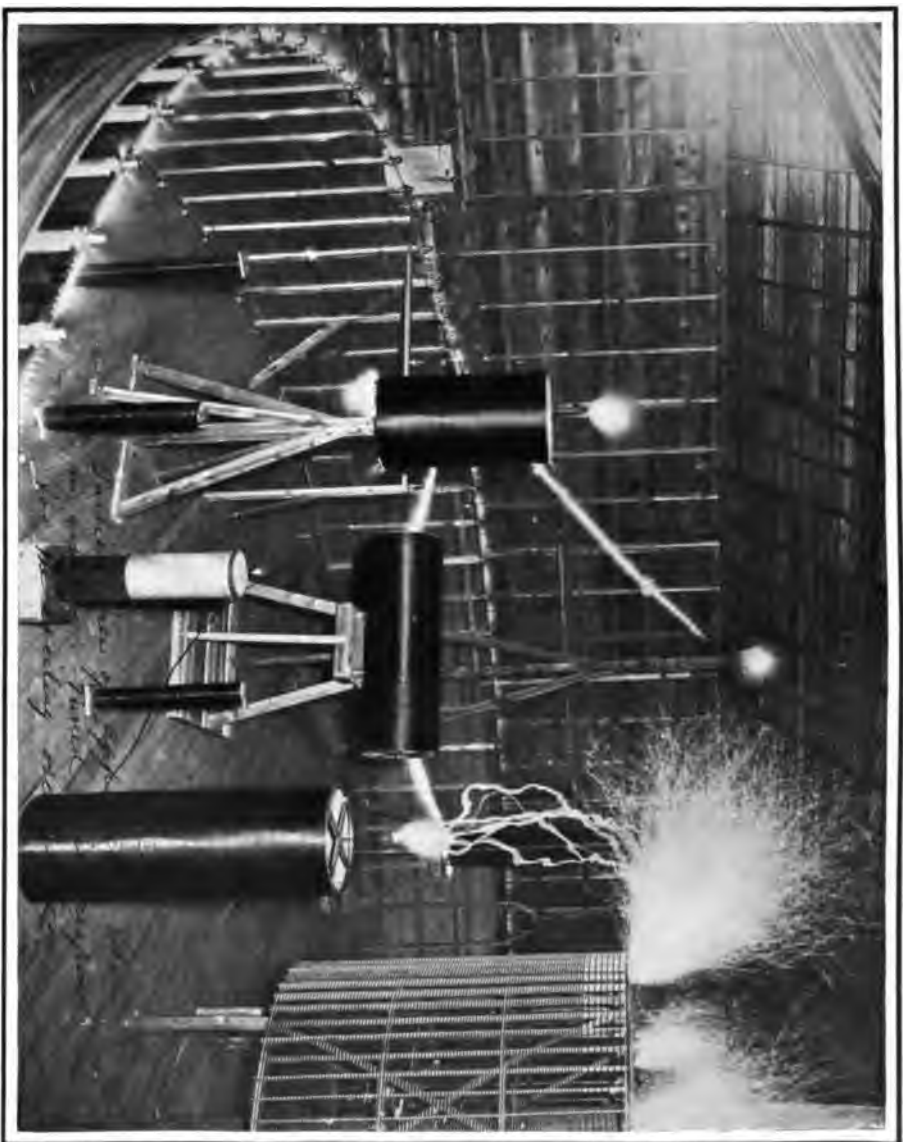


PLATE XXI.—Here we have another view of the powerful laboratory apparatus shown in our frontispiece. The groups of large coils are in resonance with an exciting primary system, and being thus tuned they respond to the exciting oscillations. These small reproductions of very extraordinary photographs convey but little impression of the magnificent discharges exhibited to an audience of scientists in this darkened barn-like room of a great inventor. Our next picture shows the same current in miniature.

1. The first part of the document is a list of the names of the persons who have been appointed to the various offices of the city of New York.

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fant is fretted by fermentation in its stomach or by some inexpressible yearning of its speechless centres—and it cannot tell why. Our necessity is to unload the internal cause of worry and the worry will fly out of the window. The worrier is in need of treatment even more than many who are plainly sick.

And practically everybody who worries is sick, or will be, though they often deny this pathological fact. Apart from hypochondria, melancholia, neurasthenia, or obvious disease of kinds most associated with mental depression the guilty organ behind the worry nine times out of ten is the wicked liver.

The sensible thing to do is to start up an active elimination at once, and follow this by correcting faults of metabolism and by restoring the functions of the liver and other organs to normal. Unless this is done there is no power of mind to stop worry. It cannot be dismissed as a joke, and it is no laughing matter. We are firmly convinced that treatment in time would check the majority of suicides and reduce insanity by half. There is a vast difference between facing real difficulties when the strength is fresh, and facing difficulties either real or mainly imagined when toxins fester the brain.

Then the reaction upon the solar plexus resembles that of shock, only it is subtle and like a smouldering fuse until there may come recovery, or the explosion and disaster.

Treatment.—Examine the tongue, in this case the index to liver and situation. Prescribe the kind of cholagogue needed. If feasible to administer an electric light cabinet bath in a proper manner do so, but if not, then advise a Turkish bath. These are co-operative measures. In some cases a digestive tonic may be needed. But the restorative uplift of the nervous forces is furnished by the high frequency current.

With a dispersing electrode on the dorsal spine apply a vigorous tonic dosage through the glass vacuum electrode to the region of the solar plexus, liver and entire abdomen.

Reverse the electrodes and apply the same action to the entire spine. Finish the treatment with inhalations of ozone.

If other symptoms are present meet the indications while administering the current. If the feet are cold warm them up with the current, and one of the marked signs of improvement will be the vasomotor and heat regulation manifested by normally warm hands and feet, and a cool head. Persist in treatment so long as evidence of functional irregularity lingers. Even if the mind clears and is no longer oppressed by morbid fears continue treatment until the physical state is restored to *par*.

CHAPTER XXV

BOYS, GIRLS, AND INFANTS

Saving the Baby. How to Help Infants Thrive. Neurotic and Anæmic Boys and Girls. The Treatment Needed. How to Finish Recovery from Epidemic Diseases. Metabolic Inertia in Children. Delayed, Scanty, Irregular or Painful Menstruation in Girls. Moping and Peaked Boys at Puberty. Sulks in Boys. Nervous Tendencies; Hysterical Symptoms; Crying Spells in Girlhood. Treatment.

THE health of the child is the foundation of the man and woman. Let us begin with the baby. An infant is a bundle of functions, as easily disturbed as the tuning of a violin. A stomach ache for a sturdy youth is a convulsion to his baby brother. A dose of opium too small to deaden a mild pain in an adult will deaden the entire life of a little child. So in the baby we have responsive nature in receptive moods for either good or bad impressions on the tender vasomotors, nerve centres, and processes of metabolism. A little thing can make the baby sick—often startlingly sick; a little of the right thing can make the baby well.

Infantile diarrhœa, summer complaint, marasmus, rickets, simple deficiency of nutrition, with paleness and sweaty head, susceptibility to the slightest draft, failure to thrive without apparent reason, all these are cases in point. Other cases occur when the baby has some acute germ infection, or is recovering from any of the sudden illnesses of infancy. In all these high frequency currents will arouse functions and help greatly to restore health.

It has been our good fortune to witness in a number of cases the swift support a very gentle general electrification with a high potential current will lend to the efforts of nature to restore health. Wherever lives of babies are highly prized this adjunct to medical treatment is priceless.

And now take girls and boys, the average of them as they pour out of school, many of them freckled and a tinge of red in the cheeks. But behind the freckles may be seen far too much anæmia, neurotic tendencies, imperfect metabolism, the evidently unfinished cure of recent acute disease, functions hesitatingly performed, handicaps to the child drifting untreated towards maturity, the while twenty to fifty per cent below the physiological *par*.

The prevalence of this state of lowered vitality in a large majority of children explains the fact that so many children "catch everything," and accounts for our common epidemics of children's diseases. The cost to the families of our nation is greater than twenty wars would be—and is for the most part sheer neglect. The modern massacre of the innocents is largely avoidable.

Go back to Chapter II and again read nature's defenses and realize the responsibility of parents who leave their children in states of impaired vitality. Normal gastric juice will resist the germs of typhoid; pure blood will protect the individual from almost all germ infections; when tissue-resistance is at par the child cannot have a chronic "cold on the chest," for she will speedily get over it, and these children will not feed the armies of consumption for the tubercle bacillus will not grow in sound soil.

Some diseases, especially diphtheria, scarlet fever, severe cases of measles, whooping cough, the grippe, all the infectious fevers, are prone to leave some injury in their wake which may appear to slumber for a time but sooner or later cripples the health of the child. Any degree of lingering invalidism that can be prevented is a great injustice to the present and future generation.

HOW TO FINISH RECOVERY FROM EPIDEMIC DISEASES OF CHILDHOOD.—Apply a gentle general electrification treatment in all cases as soon as possible after the febrile state has passed. Repeat daily. When convalescence is established begin the following local treatments:

Apply a vigorous tonic dosage of high frequency current



PLATE XXII.—This beautiful picture (as exquisite as Manet's "Boy with the Sword," which is one of the classics of the Painting Art), sets forth this boy bringing his pocket "Tesla" for the enjoyment of his beloved tonic. His sturdy strength at the age of three is a tribute to the efficacy of high frequency currents, for at the age of three days, when his treatment with them was begun, he was an ill-thriving and frail infant with but the feeblest hold on life. *Look at him well* and think how many myriads of pallid children—of all ages—need the same remedy.

to the nerve centres of the spine with the usual glass vacuum electrode and the opposite electrode over the solar plexus. Next reverse the patient and apply the same over the stomach and solar plexus. If the disease has affected the organs of the chest make the same application over the pulmonary region and let the child inhale the ozone discharge from the tip of the electrode a few times.

Repeat this tonic treatment daily until the child recovers complete health. As this method never "hurts," and can be conducted in the most considerate and careful manner it is especially useful with children and has no drawbacks. It needs only to be explained to the child and its entire comfort demonstrated, to have it accepted by the most diffident and nervous.

METABOLIC INERTIA IN CHILDREN.—Evidences of defective metabolism abound wherever children abound. Of every ten of them more than half are in the state of "out-growing" (?) something in the way of former sickness which has left them with impaired nutritional energy. They are not sick with a disease but with a condition. They need to get out of it. Their tissues are losing or have already lost a great part of the "resisting power" by which nature should protect children from epidemics and exposures. Such a condition is poor soil for growth toward maturity, and an impoverished body is a fearful handicap to the growing brain.

Parents live blind to this staring fact and physicians seldom open their eyes about it. But funeral expenses are one common consequence of parental blindness, and the surviving and unrescued children of this vast group grow into the failures of life and bear the children who "inherit feeble constitutions." What else can they inherit from feeble tissues and unfertilized nerve centres? The stock of such generations is like the crops on run-out soil. And in this field of usefulness the work for high frequency fertilization of the soil is Napoleonic in extent and tremendous opportunity.

Treatment.—With the glass vacuum electrode administer a strongly stimulating dosage of high frequency current to the entire surface of the body, first doing the front and then the back. Make the application especially thorough upon the spinal centers and over the solar plexus and digestive organs. Arouse the metabolic activity of the whole organism, and do not stop treatment till it responds.

DELAYED, SCANTY, OR IRREGULAR MENSTRUATION IN GIRLS.—This is but one expression of an under-activity of nutritive metabolism, spoken of above. It is not a matter to treat with indifference or neglect. The earlier it is treated with electricity and the function placed on a normal basis the better it is for the child. When she passes eighteen amenorrhea is practically beyond the reach of treatment, and other impairments of the function suffer from delay. Painful menstruation is needless, curable, and should never be dealt with by gin, whiskey, morphine, coal tar depressants and the too commonly used and injurious palliatives. The claims of wisdom and humanity demand that the girl shall have the function established on a normal basis and anything less than this defrauds her of her birth-right in this respect. It is easily done, nine times out of ten. The means of doing it is the same as in all other cases in which nature requires a little physiological stimulus.

Treatment.—The external treatment involves no objectionable exposure of the child and the mother should be present. In addition to general electrification to improve nutritive activity throughout the body, apply a tonic dosage with the glass vacuum electrode directly through the pelvic region with the opposite electrode under the sacrum. Over the region of each ovary increase the dosage to a more stimulating intensity and make deep pressure. These tissues are not sensitive and tolerate a vigorous current.

Next, turn the patient over and arouse the spinal centres, especially those of the lumbo-sacral spine, with a current strong enough to gradually redden the skin before the close of the administration. It will be entirely comfortable and

will leave the back in a warm glow which will feel very strengthening.

Repeat this treatment at least twice a week between periods, but for three days before menstruation is due make the application daily.

In addition to the electrical stimulus the usual blood-making remedies and correct hygiene should be prescribed. The future mothers of the country are far too important to let drift along with so vital a function out of physiologic order. Defects here are also often stairs down which women descend with facile ease to misery and the unhappiness of mis-mated man and wife. Here, at the beginning, is the place to prevent the tragedy of the marriage altar.

MOPING AND PEAKED BOYS AT PUBERTY.—This condition in boys is the analogue of imperfect menstruation in girls. The process of maturing is not supported with enough physiologic energy on the part of nature. She needs a helping hand and high frequency currents can extend it. Treat the boy on the same general plan of improving his blood, toning up his tissues, and increasing his metabolic energy. Apply high frequency currents as directed for metabolic inertia in this chapter. When this is done the boy will grow forward and upward as he ought to grow.

SULKY BOYS.—We have known many cases of this unfortunate affliction in families that failed to regard it as a curable *morbid* state. It is a common affliction, as repugnant to the helpless victim as to any of his associates. He would gladly stop it if he could but no will power can control the perversions of the liver—and that is what the “sulks” are. Simply a sulky liver. All the erratic and strangely sudden whimsicalities of this unhappy state are *liver*.

The treatment therefore, is the restoration of the functions of this organ to physiologic normal. Refer to Chapter XXI and employ the methods described for torpid liver and faulty bile circulation. But in a youth (with the quick responsiveness of nature in the young) the result should be a speedy and entire correction of the fault. Every boy dis-

covered in this bondage to an infirmity not his own should be released from it by intelligent treatment.

NERVOUS TENDENCIES; HYSTERICAL SYMPTOMS; CRYING SPELLS IN GIRLHOOD.—All these may be considered in one group as expressions of a single under-lying state. They, and other similar symptoms, are evidence of neurasthenia and patients (either children or adults) have little control of will-power over the hyper-excitability of the too irritable nerves. Therefore advice, scolding, and punishment makes children worse and does grown-ups no good. What all of them need is the physiologic stimulus of electricity to restore the lost tone of the nervous system and build up nutrition so that nature can resume her normal sway. This treatment is indispensable and there is no effective substitute.

Owing to the reactive influence of these mortifying symptoms upon the sensitive nature of many young women, preventing the enjoyment of normal life and seriously interfering with that important phase of development which grows out of hearty sports and attrition in the company of vigorous mates, it is parental wisdom to recognize the early need of treatment and apply it when a little will do much. The most careful directions are set forth in our chapter on neurasthenia and they should be adapted to each given case.

With a reasonable amount of high frequency tonic aid to the often wandering energies of nature we may spare thousands of children many of the pangs of needless torment which afflict their suffering systems and put them on the road to vigorous and wholesome minds and bodies. Morbid children are one of the "preventable" evils and high frequency currents can help prevent them.

CHAPTER XXVI

URIC ACID STATES, DIABETES AND KIDNEY DISEASES

Treatment of Uric Acid Conditions by High Frequency Currents. The Proper Rules of Diet. Treatment of Diabetes Mellitus. Rules of Diet. High Frequency Treatment of Kidney Diseases. The Superiority of Physiologic Aids to Nature in These Morbid States of Deranged Metabolism.

URIC ACID STATES; LITHEMIA.—These terms designate *under-oxidation* of foods and the consequent circulation in the fluids of the body of irritant products of nitrogenized waste in various degrees of under-combustion (as clinkers in a stove instead of fine ashes) but which are grouped for convenience in the single word, "lithemia," or uric acid. It is like the incomplete burning of any fuel in an engine fire when the draft is poor. The "draft" in the human engine may be reduced below normal by various reasons among which are a lowered state of the nervous energies of metabolism on the one hand, or an intake of rich food beyond these lowered powers to burn up. The *oxygen-exchanges* in the tissue-cells are not active enough. They can usually be made so and the condition removed.

There are many shadings of the uric acid state. Only a trace of mental dulness may mark the slight excess of uneliminated proteid waste, but in a bad case the state is characterized by dyspepsias, various forms of nervous phenomena, headaches, muscular and joint pains, bronchitis, and scanty, high colored acid urine. A coated tongue, bad breath, impaired appetite, gas in the stomach, abdominal distress and constipation are common manifestations.

Often sugar and albumin are present in the urine as well as an excess of uric acid, urates and oxalates, irritating in the ratio of their density. The reflex upon the

mind and nerve centres causes depression of spirits, impaired memory, sluggish faculties, disturbed sleep, vertigo, headaches, irritable disposition, ringing in the ears, dread of apoplexy, etc.

Joint pains and back ache are common. The skin shows an unhealthy state, with an itching tendency and eruptions. And finally deep organs and the heart take on the beginnings of disease. Prolonged irritation sets up inflammation.

The heart labors more, there is increased arterial tension, and in the long course of untreated aggravations the kidneys may become diseased, the heart fatty, the liver enlarged, and arterio-sclerosis, chronic bronchitis, or angina pectoris may be results—all of them avoidable by timely treatment with high frequency currents to promote more complete metabolism.

Drugs help but are seldom “curative” and writers who rely on drugs lay down exceedingly difficult rules of diet as the first necessity. As they cannot lift up the metabolic energy to normal they aim to pull down the intake of food materials below the normal by cutting out some very important elements of a wholesome mixed nutrition. Our plan is the opposite and more rational.

Treatment.—Restore nerve tone to the digestive system and excretory organs by the high frequency discharge from the glass vacuum electrode, using a tonic dosage over the solar plexus and abdomen, and a counter-irritant dosage over the region of the liver, spleen, kidneys, and entire back.

Restore metabolic activity to the exchanges in the protoplasmic tissues of the muscular system by muscle-toning and vigorous contractions with thick, dull sparks—the foremost energizers of metabolism in muscle substance within the domain of medicine.

Treat headache, pains, and special symptoms as directed under the proper headings in this section. Repeat daily until improvement is marked and then three times a week until healthy nutrition is established. And in succeeding years,



PLATE XXIII.—Illustrating the simple method of high frequency "Saturation." The patient sits in any comfortable chair and holds in his hands a metallic electrode connected with one pole of the current. The opposite pole should be grounded. This affords the simplest method of general electrification, and is adapted to use with children for there is neither sensation nor any disrobing, nor any trouble to the child. It is also the basis of local methods which employ localizing electrodes while the patient is thus "saturated" with the current.

if the condition relapses by reason of similar causes, repeat the same protective treatment early and avoid the troubles of neglect.

Prescribe at the beginning of treatment any internal medication that will help to start up elimination and better digestion. But as to diet, make the following rule of simple common sense the patient's guide:

Let the digestive organs rest and empty themselves by almost withholding solid food for one or two days, according to the indications of the liver. As soon as appetite and relish for food begins to develop begin to eat a simple and easily digested variety of "what you like," avoiding any article that is known to disagree with the stomach in the given case.

As improvement grows under the electrical stimulus to metabolic nerve energies, gradually resume a normal, wholesome, all-round mixed diet, regulated by no other rules than those of common sense. Eat as a well person eats, only with prudence as to time, haste, and quantity, not eating when over-heated and excited, and not eating dishes in conflicting association and the certain things which all people learn by experience are not suited to their digestion.

In a short time as compared with the results of any other form of treatment the activities of metabolism will be improved to the degree of comfortable living and safety from organic disease of kidneys, arteries and heart. And with a sufficient amount of further persistence the state of assured health can usually be achieved. Compare the simple celerity, reasonableness, and effectiveness of it with the recommendations of Haig, and especially compare the results to the patient.

We have taught this plan for many years and have witnessed its certain benefits.

DIABETES MELLITUS.—Cases of diabetes vary greatly in their course and severity. Read Chapter IV on the relations of the liver and pancreas to this disease of disordered

metabolism. We need not consider its clinical history in this small book. The main thing to set forth here is the proper treatment.

Directions for high frequency treatment are exactly the same as for any general derangement of metabolism, and as just described for the treatment of the uric acid state. In addition to the general treatment add the relief of any symptoms that arise in the course of the disease by the directions given under the respective heads throughout this section of our book. The thirst will be greatly relieved by treatment of the throat as described for "cough." It starts up the salivary secretions and wets the dryness.

The next consideration is diet. The resort to palliative and non-curative drugs (for a curative drug does not exist) has led to the arbitrary exclusion of "sugars and starches" from the diet. The result slowly passes from mere inconvenience into an unbalanced nutrition which may be called a "sugar scurvy."

The restrictions become so intolerable to some patients, when long adhered to, that the rules finally break down. The diet, once advised as good becomes a poison to the fretted tissues and the torments of late diabetes increase.

Under the metabolic stimulus of high frequency currents practically all early cases promptly recover normal functions of the liver and pancreas as respects the combustion of sugar in the tissues. The muscle-toning sparks are of great importance here. The sugar disappears. A wholesome mixed diet should be eaten from the beginning of treatment and if we cannot succeed in enabling nature to digest it we shall be disappointed in the action of our physiologic remedy.

The rule, reported by many different physicians and observed without exception in our own practice, is a definite elimination of the sugar from the urine in all early cases. In later stages, when alterations of tissues may be too great to restore the normal processes the comfort of the patient can be greatly helped, the progress of the disease held in

abeyance, the amount of sugar reduced, and release from the torments of the anti-diabetic diet assured.

DISEASE OF THE KIDNEYS.—The kidneys are subject to irritation, congestion, and inflammation, as are the other organs of the body, and nature's resources of repair follow the same physiologic principles. Equally so does the help to nature afforded by the physiologic actions of high frequency currents.

In our previous chapters on the actions of high frequency currents upon functional processes in the body we have seen how vasomotor regulation of the blood supply to the kidneys and the regulation of urinary excretion is markedly influenced by general electrification, but especially by counter-irritant applications of the current over the region of these organs. In acute conditions and in certain crises the actions of selected drugs are very important, but their curative action in *chronic* kidney disease is practically nothing. Our main reliance must be upon the restorative actions of electricity and nature.

The high frequency portion of treatment is the same as directed for the other conditions of disturbed metabolism and states of irritation, congestion and chronic inflammation. For the kidneys, follow the administrations and dosage set forth under the head of uric acid, and treat complications as found under their respective headings. Simply pay an increased amount of attention to the region over the kidneys when applying counter-irritation there.

We have in this manner personally treated many different stages of so-called Bright's disease, and with greater benefits to patients than are reported of all other methods, whether medical or surgical. In this we are confirmed by the reports of other physicians using electric currents. General electrification should not be depended on solely, as many mistakenly do, but the local actions we have described should be vigorously followed up. They are of paramount importance.

We have demonstrated their worth in advanced cases,

in one case so far beyond medical help that even digitalis refused to further support the heart and his physicians had withdrawn all medicine to let him drift. From this despairing state electrical stimuli relieved his symptoms, lent renewed tone to the functional energies, propped him up to a comfortable condition as compared with his recent suffering, and gave him some further lease of life. This was victory enough for any remedy within the knowledge of man.

CHAPTER XXVII

THE RHEUMATISMS AND THE GOUTY STATES

The Muscular Rheumatisms, Lumbago, Wry-Neck, Etc. Rheumatisms of Joints. The Various Types and Stages. The Gouty States. Directions for Treatment.

BETWEEN the twinge of a muscle and the deforming erosion of joints there are four chief "rheumatisms" and many expressions of "gout." To scientific writers at the desk *rheumatism* is mediæval, and medical journals have printed long articles advising that it be abolished, but the word is so deeply imbedded in practical nomenclature that the present author will not attempt to uproot it.

The first, simplest, and most common form of rheumatism is *muscular*. If it affects the lumbar region of the back it is called "lumbago." If it affects the cervical muscles it is called "torticollis" (wry-neck); and other names are given to it according to location.

Virchow, whose authority equals any, deemed the condition a "congestion of, and scanty serous exudation between, the muscular striæ." In chronic cases the congestion passes into a slight inflammatory proliferation of the connective-tissue. Results of treatment lead us to consider this explanation of the pathology the correct one.

The doctor who never had lumbago himself regards it lightly. That it may and often does cause agonizing suffering to patients is a trifle to him compared with the important medical fact that it "never causes death." Muscular rheumatism may range in degree from a mere occasional ache or lameness to the most crippling intensity of pain on the slightest movement, and it may pass away in a week, or it may last months and years either intermittently or constantly.

Common as it is, painful and annoying as it is, much as it often interferes with the habits and activities of the victim, the paramount fact about muscular rheumatism is the non-curative action of drugs. Neither in his medical college, nor in his hospital experience, nor in his routine textbooks is the physician anywhere taught the curative treatment of this neglected disease. Some make no pretence of treatment and laughingly tell the patient to "work it off." Liniments, plasters and blisters amuse other prescribers, and acupuncture and the cautery and cupping still remain to "try." In a mild case this medical indifference may be sufficiently irritating to the patient, but we have seen cases of such severe agony and of so many years' standing that medical teachers who lead the practice of the routine profession cannot be excused for failure to right this wrong. Every doctor should know how to successfully treat muscular rheumatism when he leaves his medical college.

Treatment.—The "indications" are plain. Virchow's pathology makes treatment require to embody three things: Heat, muscle contraction, and counter-irritation. The definite, usually swift, and certainly curative remedy is a rightly selected dosage of electric current. When it is made to carry the actions of heat, irritation and contraction into the affected tissues the serous exudate will be driven back into circulation, the blood-vessels will lose their congestion and the pressures which give rise to pain will cease. The patient will be comfortable and well.

For a recent mild case have the patient "posture" the affected muscles so as to set up pain by the stretching or moving of the fibres. At the same time apply a sharply counter-irritant dosage of high frequency current to the affected muscles. When the pain of one position or movement is abated make any other posture that will set up more pain, and remove it in the same way. When all movements and strains of the muscles are unable to cause further pain or lameness the treatment is ended.

In a fresh lumbago only a day or so old this entire and



LUMBAGO

PLATE XXIV.—Illustrating the Author's correct principle of muscle posturing in the treatment of Lumbago. The forcible forward bending puts the lumbar muscles on the stretch and makes painful compression on the congested swollen fibres and the nerves ending in them. Apply a counter-irritant, heat-inducing, muscle-contracting dressing in this posture until the most vigorous bending ceases to set up pain. Rising from a chair is one of the most painful "posturings" in lumbago. Apply counter-irritant current as patient slowly rises. Apply it with repeated rising and sitting until it is done with natural comfort. Test other postures and search out every movement that can be made to produce pain, and treat till pain ceases. Repeat daily, or as needed, until the patient remains well.

lasting cure is often accomplished in five minutes' treatment. The longer the condition has existed the longer it takes to secure the relief. Persist in the use of the current until the relief is obtained even if it takes half an hour at the first seance. Repeat treatment daily till no symptoms return.

If the case is chronic when first seen and deep connective-tissue is affected this dosage of current will not suffice alone. Select the current of lower frequency and potential which gives the effect of the so-called "static induced" current and apply it with sponge covered faradic electrodes. Regulate the dose to cause a deep muscular tetanus within comfortable tolerance and press the active electrode deeply into the seat of pain. Hold it steadily until the pain ceases. Then move to another tender point and repeat the removal. In this way search out and treat locally each tender point until all are free from further distress. This deep contraction of the muscular striæ will combat the stasis of inflammatory exudate and cause its rapid absorption, with relief to the rheumatic symptoms. In these cases a number of treatments, daily at first and then every second day, will be required to complete the relief and make it as permanent as possible.

If any case of supposed muscular rheumatism resists the above treatments when they are properly administered it is certainly complicated with some other or constitutional condition which requires general elimination in addition to the local treatment just described.

RHEUMATISM OF JOINTS.—Acute inflammatory rheumatism (rheumatic fever) is a disease with varied complications and an irregular recovery, during which the help of high frequency currents to relieve symptoms and carry convalescence to a speedy and normal finish can be made of exceeding value.

Chronic rheumatism of the joints, one or more, may either develop from an uncured acute attack or arise as an apparently separate disease. There is no curative drug

treatment. The insidious progress of this form of rheumatism is slow, persistent and obstinate. Late stages may witness impaired movement, ankylosis, distortion and deformities.

A more destructive variation of chronic arthritis is equally well known by two names—rheumatic gout and rheumatoid arthritis. It is marked by deposits about the joints, loss of motion, deformity, erosion, pain, discomfort, and progressive crippling, especially of hands, feet, or shoulders. Atrophy of the related muscles and neuritis follow after the period of inflammation, and the whole condition is expressive of an altered metabolism. There is no curative drug treatment.

Of a third phase of rheumatic joint suffering Hare's Practice of Medicine remarks: "It must not be forgotten that within the last few years it has been proved again and again that the gonococcus may find entrance into the general system from the urethra and there cause the most disastrous consequences. If it gains access to the joints it may not only produce a temporary gonorrhœal arthritis, but it may also cause a chronic arthritis which is usually multiple, and sometimes is so widespread that the patient is crippled hand and foot, finger and toe, for the balance of life, the incapacity of the patient being even greater and more rapid in its onset than if he were suffering from rheumatoid arthritis." We have seen such a case in which the crippling and pain exceeded any other form of rheumatism. The salicylates do not benefit this disease. Drug treatment is nearly futile.

The gouty states cover conditions varying from mild lithæmia to the acute attack of "gout," and from barely noticeable deposits to badly swollen and gouty feet or hands or knees. The kidneys, liver and all organs concerned in metabolism share in gout and may become the seat of symptoms or take on the pathology of disease.

It is profitless to discuss these various labels of surface identification. The underlying fact in all these states in

the stages when it is possible to apply treatment with success is an altered activity with metabolism, no matter what the cause or what the name of the special rheumatism or gout may be. To this must only be added the necessity of destroying the local supply of continuing infection when the cause is the *gonococcus* of Neisser. We shall therefore pass directly to treatment and shall require to consider but three things: relief of symptoms, elimination of waste products, and improvement of nutritive exchanges (metabolism).

Treatment.—As some of these cases tax the fullest resources of therapy it is obvious that we must seek help from several co-operating measures. The first of these to prescribe is diet. Without taking space to argue the matter we will briefly say that our experience is wholly against the routine “dieting” of these diseases practiced by theorists and advised in text-books. The result of the diet plan in all chronic diseases which require long years of it is an unbalanced nutrition, and this semi-starvation is as poison to the patient. When the patient has no other treatment at all, or only drug treatment which is nearly the same thing, the diet slip is a *placebo* to dodge the real issue.

With electrical treatment to build up the metabolic processes to enable them to assimilate foods, the patient should eat (with a gradually extending and widening variety) the full wholesome mixed diet of normal health; simply using the common sense judgment of avoiding foolish mixtures and plain indiscretions.

Climate may come next in consideration here. Cold is a poison to many rheumatic and gouty people. Few can follow summer around the world but all can dress warmly or comfortably, according to the season. This should be done.

Drugs have their place. No skillful prescriber of the *materia medica* can fail to recognize certain symptomatic benefits to be derived at times from selected drugs, regard-

less of the fact that for the main disease drugs are non-curative.

But the main remedy, more nearly curative than all others combined and more definitely helpful when still unable to cure, is the high frequency current and the alterative-nutritional-and-upbuilding resources of electricity.

This treatment must be both general and local. The general alterative and eliminative treatment is auto-condensation—the chief form of general electrification with high frequency currents. Commence with a moderate dosage and short sessions, increasing the dosage and time according to results noted. This should be supplemented by the eliminative action of the electric light cabinet bath.

Local treatment should be thorough and comprehensive. It should include the affected joints, the related muscles and the spinal cord. Apply the current through the glass vacuum electrode but regulate the intensity of dosage according to the action required by the different states of the different tissues. Thus, sedative, tonic, stimulating, and irritant intensities will be needed, as well as alterative sparks and muscle-contracting applications with other electrodes. The diseased condition is complex and the treatment is complex to meet the conditions. No one routine can fulfill the requirements.

When joints are swollen and painful but without active inflammation add to the vacuum tube treatment a persistent attack upon the nodes with mild alterative sparks. Avoid using an intensity that will cause pain. A mild spark is indicated. This promotes absorption and reduces the size of the joint.

When muscles are stiff and lame treat them on the same principle as directed in muscular rheumatism. Do not forget the posturing. This is always important in treating muscles. Neglect of it yields poor results.



PLATE XXV.—Treatment of Knee. In a local application to the knee joint (or any joint) for any form of arthritis or synovitis whether rheumatic, gouty, or traumatic, expose the part, secure the desired dosage of current, interpose a dry resistance if counter-irritation is indicated, and move the electrode over the affected area. Localize the action upon each point that needs it until the fullest benefit is obtained. In muscular conditions put the muscle fibres on the stretch to develop the pain and then apply the current until pain ceases. Repeat according to the relief obtained.

CHAPTER XXVIII

SOME LESIONS OF THE SKIN AND MUCOUS MEMBRANES

The Extensive Use of High Frequency Currents by Skin Specialists. Classification of Skin Diseases. The Principles of Treatment. Summary of these Diseases Successfully Treated by High Frequency Currents. The Cure of Boils. Technic for Removing Facial Blemishes.

IN chapters on clinical experience in the first section of this book we find evidence of extensive use of high frequency currents among specialists in the treatment of cutaneous diseases. In the majority of cases only a limited technic has been mastered by individual physicians and each has made his apparatus do much less good than it could have been made to do with greater knowledge of the principles of physiologic healing. But as a whole a wide range of skin diseases has been successfully treated by the different intensities of electrical stimuli. The total of the extracts cited is proof of this.

Although skin diseases have seventy or more diagnostic names attached to them they fall into seven classes, and the principles of nature's restorative actions in healing them are few. We either have inflammations to be allayed, or germs to kill, or over-active nutritional exchanges to regulate, or under-active nutrition to increase, or altered secretions to regulate to normal, or sensory disturbances to soothe. Outside of new growths this covers the field.

We also deal with *acute* and *chronic* processes, and it is an old and fairly general rule that acute activities of the tissues require *sedative* treatment, while chronic sluggish or degenerative states require *stimulating* treatment. This maxim is especially useful in the case of physiologic remedies.

The key to results is not in a hundred salves, lotions, plasters, powders, and prescriptions, but in the application of correct therapeutic *principles*. The help that can be got out of high frequency currents of electricity is about as follows:

A sedative spray can be made to calm irritable nerve endings, quiet pain, abate itching, lessen congestion and reduce active inflammation in a part, and the ozone discharge in the same spray (in denser dosage) can dry serous and mucus secretions, and deodorize, disinfect, and heal moist and suppurating lesions.

The mild tonic spark and the tonic dosage of current through the glass vacuum electrode can be made to increase the blood supply in the part, dilate capillaries, promote absorption, abate pains, combat stasis both venous and capillary, reduce subacute inflammations, and by improvements in local nutritive exchanges in the tissues be the means of aiding the reparative processes of nature.

The same forms of discharge in greater intensity can be made stimulating in a more active degree than in the tonic dosage. Along this line of action up to sharp counter-irritation they can be made to alter states of under-nutrition and exert the actions of rubefacients, vesicants, and all shadings of such actions without actually causing a blister or in any way damaging the skin as chemical agents do.

General electrification, and the general application of tonic or stimulating applications to the spinal centres, solar plexus and organs of digestion can be made to alter and improve the general nutrition and the nutrition of the skin as well. This is an important item in the cause and cure of many skin affections.

When excessive connective tissue proliferation exists, or hypertrophy, as in the case of warts, the escharotic spark can be made to cut down the excess and leave the skin clear without a mark or scar.

When a local pustule requires an intensity of nutritive alteration the same spark can apply it. When a zone of



PLATE XXVI.—Illustrating application to lesion of skin. The tube here used in a high vacuum, protected treatment-tube for x-ray action in parasitic and other skin diseases which require it. The active end of tube is flat and is held in direct contact with the skin, the discharge being localized on the area of contact. Much of the recent high frequency work on skin diseases has been done with tubes of this character. The operator is entirely protected from disseminated rays as there are none.

induration surrounds a lesion and prevents nature from reaching the suppurating tissues with her leucocytes the thick, dull, muscle-contracting spark will force the blood through, soften the hard barrier, stimulate the absorption of exudate, and with the ozone spray and tonic application to the field of granulating tissues they will heal with wonderful rapidity and completeness.

To these resources of physiologic action in support of nature's efforts add the measures selected out of the routines of dermatology that will protect, or comfort, or otherwise assist in the sum of treatment. With the ample reports in our first section, and with his general knowledge of therapy to guide the physician it is not necessary to repeat here a long list of skin diseases and give separate directions for each. The principles should suffice.

Among the various lesions reported as successfully treated by different physicians in our clinical chapters of Part I are mentioned: erythema nodosum, urticaria, eczemas, moist and dry, zoster, lichen planus, acne of all degrees, acne rosacea (extreme cases), sycosis, pityriasis, dermatitis, boils, carbuncles, ulcers of all varieties, suppurating sinuses, tinea favus, scabies, chloasma, ichthyosis, molluscum contagiosum, comedo, warts, keratosis pilaris, pigmented and hairy moles, port wine marks, alopecia, alopecia areata, keloid, painful small scars, dermatalgia, lupus (both forms), scrofuloderma, cutaneous syphilides, x-ray excrescences on hands of operators, primary epithelioma, mycosis fungoides, hyperidrosis and anidrosis, pruritus (anus, scrotum, vulva and general), anal fissures, hemorrhoids, enlarged and diseased tonsils, etc.

" Malignant or semimalignant lesions of the skin, epithelioma, lupus, lupus erythematosus and sarcomata, when of small size and conveniently located, have been destroyed in very many instances by the caustic (escharotic) spark from a metallic electrode connected to one terminal of a coil transformer, the other terminal being grounded or connected to the person of the patient.

"This little operation is exceedingly painful for the two or three seconds that it lasts, but is so brief that it is usually borne without flinching. There are many reports in confirmation of this, especially from France. I know of no better means of aborting a commencing boil, as it does in a moment what nature requires several days or a week to accomplish. In other words cocci are instantly destroyed (together with the follicular wall) and the leucocytes have simply a small inert necrotic plug to deal with, which they usually do with but little accompanying inflammatory reaction." (Piffard in *New York Medical Journal*.)

If any reader who presumes this treatment of small foci of infection (as boils) to be new a reference to pages 1030-1031 of one of the present writer's books published in 1897 will disclose what we were doing at that time with the disruptive spark, and directions for using it in the cure of boils.

The following remarks by a skin specialist are instructive as a supplement to this chapter:

"To remove blemishes from the face requires attention to the cosmetic result as well as to the destruction of tissue. The high frequency current is used by the author to remove warts, freckles, pigmented and vascular moles, etc., and in the majority of cases, with very satisfactory results. The most pleasing feature is the healing without scar, or at the worst, only a soft pinkish scar of soft texture. The electrode used is a pointed metallic needle insulated to the point by a covering of heavy rubber and inserted into a suitable handle.

"Make the site of application as clean as possible. Put the point of the electrode in contact with the part and commence with a mild current. Then increase the intensity of the current and withdraw the point to give the length of spark-gap that will create the amount of caustic action required for the tissues under treatment. This may vary from a quarter to a half inch, or so.

"In duration of application, do not exceed a reasonable tolerance of the patient. When that point is reached in-



PLATE XXVII.—Illustrating the reduction of an acne pustule by the metallic point electrode and an escharotic spark discharge, as described in the text of Chapter XIII. The interrupting handle of the electrode is connected with one terminal of the current, adjusted to a very small spark gap. This method is a great improvement in many cases upon the older cautery action of the low voltage continuous current and replaces it with better and quicker results, when indicated, especially in tissue hyperplasias. The text deals with this method very fully.

stantly take the electrode away. Rest the patient a moment and then repeat. Thus, in a divided treatment secure the results desired without giving the patient cause for complaint of needless pain.

"The first action of the spark is to cause a constriction of the blood vessels, a blanching, and then a dilatation and reddening of the area. When the part is vascular an oozing of yellowish or reddish serum takes place. Soft non-vascular warts quickly shrivel and blacken and there may be little or no discharge. They dry up and fall off and nothing is left on their site.

"It is not essential but is advisable to lightly dress the wound after such a treatment.

"In treating vascular *nævi* from half an inch to an inch in diameter, treat half or less at the first application, leaving the remainder for further daily installments of the sparks until the area is all treated.

"A heavy yellowish or brownish scab forms over the part which the spark has cauterized, this scab falling off in from six to ten days.

"Deep port wine marks may require several applications, and although the improvement is always considerable they cannot, as a rule, be entirely obliterated.

"The action upon hairy *nævi* does not extend deep enough to destroy the hair follicles (with current used by the author) so that the galvanic needle is frequently required to complete the obliteration.

"One small scar was treated in this manner and it disappeared through the development of capillaries in the scar tissue."

CHAPTER XXIX

THE "FULGURATION" HIGH FREQUENCY TREATMENT OF CANCERS

What Fulguration is. Summary of the Method. Abstract of Results.

ALTHOUGH our conservatism decides us not to consider at length the treatment of cancer by various electrical measures in this book, yet so many physicians have been accustomed to look to the present author for directions in all that pertains to electro-therapy that a very brief summary of the technics of *fulguration* treatment will be given here.

It is one of the weaknesses of medical literature that the clear pathway through a perfectly understandable subject becomes often choked with weeds in the way of words that make the reader think he has turned a corner and is on a new track. This is due to the failing inherent in some minds to seek the unusual or novel, thinking perhaps thus to get greater credit for originality or surpassing accomplishment above other colleagues working in the same line. It simply confuses non-expert readers and does no one any good.

For a century and a half the disruptive electrical discharge (the abrupt spark), was simply called the disruptive spark discharge. But lately, as if we were being introduced to a *new* abrupt, sudden, *disruptive* discharge of an electric current we find the word "fulguration" with novelty on its wings bringing the old spark into new uses, or uses that extend the old. And eminent physicians and surgeons who would not admit the slightest interview with the static spark listen to "fulguration" and take much notice of it. So runs the world.

"Fulgur" signifies *lightning*. Anything that is "fulgurant" is "sudden, coming and going like lightning." That

is all there is to the word, and that is just what the disruptive high potential spark has been since 1745, when it was first subjected to medical application. It simplifies the subject to know this. The rest is mode of use and dosage.

Current used by French Observers.—High frequency current from coil transformer, Oudin resonator, electrolytic break, unipolar discharge for mild action, bipolar discharge for profound effects.

Electrode used by same.—A hollow metallic conductor within an insulating tube of hard rubber (of various lengths and curves for different parts of the body), and marked with a centimetre scale at the upper end where it emerges from the insulator. The metallic rod being movable in the tube is thus adjusted by the scale to the exact spark-gap desired.

The heat produced by the spark causes a coagulation of serum in the lower end of the insulating tube. This may obstruct the discharge of current, or if persisted in, may scorch the tube. To prevent this, a current of cool air is passed through the hollow conductor of the electrode, by attaching to its upper end a soft rubber tube from a tank of liquid carbonic; or, in case strict asepsis is essential, as in abdominal operations, specially prepared aseptic air may be employed for this purpose.

The French authority also deems the heat effects objectionable to the tissues and prefers to eliminate them entirely, in the manner described.

Technics.—The operation of fulguration consists of three steps:

1. Sparks are applied to the diseased tissue for the purpose of preventing hemorrhage, to modify the mass so that it can be more easily removed, and to obliterate the small blood and lymph channels and thus minimize the chances of re-inoculation and resorption.
2. The removal of all microscopical evidence of disease, either by the curette or knife. This overcomes the neces-

sity for subsequent treatments, and prevents absorption from an extensive slough.

3. The final application of the spark. Experience is necessary to determine the exact strength of current, intensity (length) of spark, and duration of action required for a given case.

Results.—The immediate effect of fulguration is the production of a coagulum, followed by a profuse sero-sanguineous discharge, persisting for about twenty-four hours, and replaced in several days by sloughing of the necrosed tissue. Granulation is very rapid and the resulting scar is surprisingly æsthetic.

An interesting effect is the inhibitory influence exerted upon malignant tissue left in situ. Not infrequently enlarged glands, nodules, and other malignant foci lying well beyond the zone of treatment will disappear through caseation and absorption, or by sloughing and cicatrization.

In all cases a period of inactivity of the malignant tissue (which cannot be removed by treatment) occurs which may last only a few weeks or several years. But it is advisable whenever possible to thoroughly remove all evidences of the disease and then to keep the patient under observation indefinitely, and fulgurate immediately when a return of disease is demonstrable.

The superior results obtained in cases of cancer by the method depend upon the vaso-constriction, cell destruction, profuse serous discharge, and the local and general reaction of the organism.

The vaso-constriction diminishes the chance of reinoculation by resorption. By cell-destruction is meant not only the actual escharotic action of the spark but also the reaction of the adjacent tissues. The treatment appears to have a selective action upon the cancerous cells.

Following the vigorous fulguration of a cancer an inflammatory reaction is excited in the surrounding tissues and not infrequently cancerous cells contained therein seem to retrograde.

The heavy serous discharge plays an important part by washing out many malignant cells, and also, the vigorous phagocytosis which is found to accompany this discharge is extremely important. A further explanation of the durable results is to be found in the increase in the vitality established by the current in surrounding healthy tissues, enabling them to cope more successfully with the disease.

Extracts from a few reported cases.—Case 1. A woman with large ulcerating epithelioma of forehead, affecting frontal bone. Several surgeons refused to operate. Fulguration and curettage on January 5th, 1907. Healing complete in six weeks. Slight recurrence at end of twelve months. Fulguration repeated. Patient well at time of writing.

Case 2. Extensive ulcerating epithelioma of right orbit. X-ray treatment had failed. Surgery impossible. Fulguration and curettage on September 6, 1907. At time of writing only a small unhealed area persists.

Case 3. Carcinoma of female breast with invasion of the muscular tissue and involvement of axillary glands. Patient very cachectic. Fulguration with ablation of the mass on May 10th, 1906, followed by complete healing. Two years after operation patient was in good local and general health. A part of the growth was left untreated and in place. A recent microscopical examination reveals the presence of malignant cells but there is no evidence of activity.

Case 8. Epithelioma of the cervix and surrounding tissues. Inoperable. Ablation by vagina as complete as possible, followed by fulguration on December 26th, 1906. Healing perfect and rapid, with perfect health up to present time.

Case 9. Epithelioma of rectum of very rapid development. Fulguration and curettage on November 1 and 27, 1906. When last seen patient was in splendid health.

“Case of physician. Aged 62. Rodent ulcer of inner angle of eye, existing for three years. Size of kidney bean.

X-ray treatment was without benefit. Six applications of high frequency current from metallic electrode caused complete disappearance. Was treated in 1905. When seen in 1908 there was no evidence of activity and the site of the lesion appeared like normal skin with the exception of a pale red color."

CHAPTER XXX

A CHAPTER OF SUNDRIES

Alcoholism and Drug Addictions. Amenorrhœa. Automobilist's Neuralgias and Eye Symptoms from Cold Winds. Anæmia and Chlorosis. Asthenopia. Cold Extremities. Impotence. Habitual Invalidism. Malaise. Malarial Cachexia. Menopause. Milk Deficiency in Nursing Mothers. Nocturnal Emissions. Pregnancy. Perspiration in Excess, under Arms or of Feet. Spinal Irritation. Typhoid Spine. Writer's Cramp and all Chronic Fatigues from Overwork of Special Muscles.

ALCOHOLISM AND DRUG ADDICTIONS.—To stimulate spinal centres apply counter-irritant dosage of current to the spine. Tonic dosage to solar plexus. To stimulate muscular system apply thick muscle-toning sparks to the muscle masses. For general nerve sedation and tonic effects employ auto-condensation alternated with general tonic application to entire body with glass vacuum electrode. The eliminating electric light cabinet bath is very important here.

AMENORRHŒA.—General electrification as nutritional alterative. Counter-irritant frictions to spine to stimulate spinal centres. Tonic application to digestive organs and solar plexus. Mild sparks to pelvic region.

AUTOMOBILIST'S NEURALGIAS AND EYE SYMPTOMS FROM COLD WINDS.—Sedative spray to region affected. Or, sedative application with glass vacuum electrode.

ANÆMIA AND CHLOROSIS.—General electrification to improve nutrition. General tonic treatment to entire body with glass vacuum electrode. Counter-irritation over liver and spine.

ASTHENOPIA.—Stimulation to spine by counter-irritant dosage. Tonic dosage to region of eyes and back of head with glass vacuum electrode.

COLD EXTREMITIES.—Counter-irritant frictions to spine

and solar plexus. General tonic application to entire body. Vacuum electrode.

IMPOTENCE.—Counter-irritant application to entire spine, especially lower centres of lumbo-sacral region. General tonic application to entire body, especially liver, solar plexus and digestive organs. The essential to success is the restoration of unimpeded normal vigorous circulation of arterial blood, not only through the genital organs but for the entire body. Venous stasis inhibits erections.

INVALIDISM; HABITUAL.—To rouse dormant energies out of this state apply counter-irritation to spine, muscle-toning sparks to limbs, and general tonic administration to entire body.

MALAISE.—In states of lassitude and languor, without apparent cause, unload the portal circulation by a laxative, and apply high frequency counter-irritation to spine and liver. Also tonic application to solar plexus and digestive organs.

MALARIAL CACHEXIA.—Besides quinine in all cases, and especially when quinine does not restore vigor, apply counter-irritation to spine, muscle-toning sparks to legs, and general tonic dosage to entire body.

MENOPAUSE.—For the nervous symptoms use auto-condensation and general sedation to spinal centres with glass vacuum electrode. Treat other symptoms as directed under special heads.

MILK DEFICIENCY IN NURSING MOTHER.—Stimulate lacteal glands to increased secretion by tonic application with glass vacuum electrode around region of the breasts. Effect is excellent and agreeable. See Plate IV.

PREGNANCY.—For many of the reflex nervous symptoms of this period electrical sedation is the best remedy—safe, tonic and beneficial to both mother and child. Auto-condensation as a general alterative. Sedative-tonic applications to the spine. Treat symptoms as they develop. We have many times seen the troublesome nausea controlled by general electrification.



PLATE XXVIII.—Illustrating a mild vacuum-tube discharge applied to the eyes for tonic effects, using a special bifurcated electrode. The patient is seated upon the insulating pad and hence is charged with "auto-condensation" effects. The operator holding the electrode should ground it by connection with gas pipe or water pipe going to moist earth, and regulate the intensity of dosage through his spark gap. It is an agreeable and beneficial application in conditions requiring sedation, stimulation, or tonic effects. In functional asthenopia it can produce a marked improvement in the sight.

NOCTURNAL EMISSIONS.—Tonic applications to spine and entire body. Counter-irritation to centres of lower spine. Sedative-tonic application to seminal vesicles. Remove irritability wherever found.

PERSPIRATION.—Excessive perspiration under arms, or of feet, especially if of unpleasant odor, annoys many people. To restore the sweat glands to normal action apply a drying tonic dosage of high frequency current with the glass vacuum electrode. Dry the part with a towel and apply toilet powder as often as needed during the first few treatments until secretion is got under control.

SPINAL IRRITATION.—Find the points of "irritable tenderness." Apply to each in turn a sedative dosage through the vacuum electrode until all irritability is removed. Then make a general tonic treatment to the spine and entire body to improve the general nutrition and nerve tone.

TYPHOID SPINE.—Treat same as spinal irritation.

WRITER'S CRAMP AND ALL CHRONIC FATIGUE FROM OVER-WORK.—Read Chapter III on the physiology of fatigue in muscles and nerve centres. Elimination is the first essential of treatment. The best eliminant is a proper electric light cabinet bath in the apparatus devised by the author, in which the proportions of heat to light-radiations are correctly adjusted. Repeat three times a week. After each bath apply a tonic dosage to the entire body with the glass vacuum electrode, increasing the intensity to strong counter-irritation on the spine and affected muscles. Also apply, with care and moderation, a few mild muscle-toning sparks to the affected muscles before finishing with the counter-irritation. If the arm is the part affected and feels heavy and lame the instant rest for it is a rapidly applied counter-irritant spray swept over the tissues through a dry resistance cloth of four (or enough) layers.

If the case is in an acute stage treat daily for a few times and it will probably clear up at once. If very chronic and severe, begin with daily applications and finish with treatments three times a week. Moderately affected cases soon

improve and with skilled treatment a useful arm can be attained and held permanently. We have successfully treated many cases during the past fifteen years.¹ In the most extreme cases all painful symptoms can be removed (a great boon to these sufferers) and much improvement can be secured but the final results depend on complications and conditions which no one can estimate for a given patient without having personal charge of his treatment.

¹ The author's treatise on "The Cure of Writer's Cramp," a monograph on the subject, has been out of print for five or more years. It was published in 1898.

CHAPTER XXXI

ARTERIES, VEINS AND HEART

Arterio-Sclerosis and Its Treatment. Purpura. Varicose Veins and Ulcers. Phlebitis and Its Treatment. Functional Irregularities and Organic Diseases of the Heart. The Physiology of Treatment. High Frequency Methods. A Few Cases.

OF the thirty or more technical subdivisions of disease affecting these portions of the circulatory system *nature* recognizes but *two* underlying conditions and her remedies are few. The organic structure is that of muscles, and diseases are (1) inflammation or the results of inflammation, or (2) the outgrowth of imperfect metabolism.

As a drop of water wears upon a stone so all the organs of the body wear and fret and suffer in cell growth and nerve tone from continued irritation of waste products in the process of difficult and incomplete excretion. So that in all cases, once acute inflammation is allayed if it has been present, the key to improved organs is improved metabolism.

ARTERIO-SCLEROSIS.—Remaining undiscovered by the public for many years this *ageing* of the arteries suddenly achieved a world-wide notoriety by the press notice of d'Arsonval's results of treatment—which were the same results that many physicians have been obtaining for ten years past. But fame is a queer bird and flies from strange nests.

Arterio-sclerosis is a slow and low-grade inflammatory degeneration of the vascular system. It is a nutritional impairment of elastic integrity of the arterial walls. The muscular fibres lose by slow degrees a little of their softness and stiffen with inorganic deposits somewhat as bones become more brittle with advancing age. No one who grows old can avoid it but when the alteration begins too

early and strides too fast it is a disease, and one that can be helpfully treated by high frequency currents.

The alterative process results in an overgrowth of the connective tissues of the arteries, followed by calcareous deposits, and these changes may extend to the capillaries and veins. As a result of the impairment of the arterial circulation there occur fibrous degenerations in other organs, resulting in loss of elasticity in the walls of vessels, increase of arterial tension, narrowing of the calibre of smaller vessels, and impairment of the nutrition of the organs supplied.

The principal causes leading to these changes are (apart from the normal one of old age) heredity, sex, the drink habit, syphilis, lead-poisoning, diabetes, malaria, gout, rheumatism, uric acid states, Bright's disease of the kidneys, exposure, and any long continued irregularity and departure from good habits.

The internal surface of the affected vessels (and the process affects certain vessels more than others) is irregularly thickened with gelatinous, or fibrous, or calcareous deposits. If the calcification becomes extensive the artery is changed into a hardened and stiffened tube, easily cracked and badly fulfilling its function as a carrier of blood to the tissues. In time the surface of the thickened deposit is destroyed and ulcers form, which may be covered with masses of thrombi—a grave menace to life.

So far we have considered general arterio-sclerosis, but it is not always general and has many local manifestations. A study of these was reported in 1908 by the Assistant Professor of Pediatrics of the George Washington University and Consulting Physician of the Garfield Memorial Hospital, Washington.

He cites statistics concerning some 3,500 cases of actual arterial disease as disclosed by autopsies and positive diagnosis. He shows that many times a *local* sclerosis affects internal arteries and cannot be diagnosed by superficial examinations. In one series of 1,000 autopsies there were

400 cases of arterio-sclerosis and of these only 154 could be determined in life. "When this disease is localized in the renal, pancreatic, gastric, and hepatic vessels the more frequent cause is over-alimentation, and this factor, combined with mental strain and anxiety is productive of local degeneration in the arteries of the brain. Acute infections also produce focal degenerations which later become an important factor in the development of local or general arterio-sclerosis."

The thickened and altered state of the artery is due to the swelling of its elements, the new growth of connective-tissue and the deposit of round cells. Fatty degeneration of the inflammatory products is the common sequence.

These changes work in a circle. The loss of vascular elasticity hinders the propulsion of blood by the heart, increases its work, raises arterial tension, and finally leads to hypertrophy of the left ventricle. Then the nutritive vessels and muscle of the heart suffer. Other organs are impaired by depraved blood-supply, their vessels degenerate, and among the sequelæ and consequences of this condition are cerebral apoplexy, thrombosis and embolism, or aneurysm, myocarditis, angina pectoris, chronic kidney disease, gangrene, etc.

The advantage of *early* attention to correct the nutrition and retard this process need not be framed in words for it is self-evident. No drug can cure the evil. It is a matter in which the patient must put his shoulder to the wheel and help. He must adopt good habits and live normally. Must face the necessity of proper sleep, elimination, regulated functions, and moderation in all things; but above all, in respect to treatment, he must persistently profit by the metabolic stimulus of high frequency currents of electricity. There is absolutely no remedy competent to take their place.

High Frequency Methods.—In the early stage without liability of arterial rupture the most vigorous stimulation of functions (especially of muscle-contraction) should be em-

ployed, with special attention to the spinal nerve centres and the liver and kidneys and digestive apparatus.

General electrification by the auto-condensation method exerts a mild and general influence upon cells, centres, and metabolism, and can be alternated with more active local measures. It has been the chief reliance of the French, who rarely develop the utmost resources of local technics. They are not a mechanical nation nor are their physicians ingenious in manual dexterity.

Local Applications.—Apply a strong tonic and nutritional dosage of high frequency current through the glass vacuum electrode over the entire spine. Redden the surface if the skin is not eruptive and will tolerate the stimulating intensity with comfort, but do not exceed tolerance—this always depending on the state of the skin.

Next repeat the same intensity of stimulation over the stomach, solar plexus and liver.

If the apparatus available affords command of a thick, muscle-toning dull spark discharge use it on all the thick muscle-masses of the thighs, calves of the legs, and back. But do not annoy these tissues with a thin and merely biting spark. Unless the correct dosage is available omit it altogether.

In addition to these measures we still have further electrical resources of the utmost value as aids to elimination in the light bath cabinet. When this help can be utilized with proper dosage of radiant heat and luminiferous rays it joins the high frequency current as a veritable right hand. But it is unfortunate that in most cabinets of this sort, especially those in commercial places, submit the patient to torment rather than to the pure *luxury of the properly balanced bath*. The temperature of an efficient cabinet, as designed by the author in 1906, induces the desired active elimination at from 85° to 95° F., and rarely rises above 100° F. The patient is not only entirely comfortable during the cabinet treatment but enjoys it.

In an advanced case of atheromatous degeneration the

actions must be the same in principle but modified to the degree of safety. The main modification a theorizer might think necessary refers to muscle-contractions for the nutritive benefits of exercise. And prudence assuredly should be in command of the treatment, but personally we have never witnessed the slightest harm or distress or the faintest trace of inconvenience from the competent administrations of the above outlined treatment in its entirety even in the most advanced cases we have met. So long as the patient is able to walk, so long is this treatment safe and beneficial.

The symptoms of arterio-sclerosis are not so apparent or so disturbing in the slow course of the disease as might be supposed. Nor does a man feel serious jar on his way to the ground from a moderate distance above it. The potentialities of damage are present, however, and it is the ominous ending of the condition that swells its importance in the medical mind. Preventive or retardative treatment is fortunately available.

PURPURA.—The subcutaneous extravasation of blood which is called "purpura" "occurs most frequently in debilitated individuals," hence the apparent application of high frequency tonic action to its treatment. Some cases are associated with rheumatism. All treatment aims at improving the quality of the blood and the tone of the vasomotors, hence electricity is among the chief remedies. Employ general auto-condensation and general treatment of the body with the glass vacuum electrode, and sparks if the latter are available in proper muscle-toning dosage.

VARICOSE VEINS AND ULCERS.—Treatment of varicose veins in all states of unbroken skin should aim to build up the supporting tonicity of the muscular environment. That this can be done with a vast improvement upon rubber stockings and by discarding their deceptive aid at the first seance, we have been demonstrating for fifteen years. Long, thick, muscle-toning high potential sparks over the affected limb, on the spinal centres, and upon the general muscle-masses

of the entire body for alterative, nutritional, circulatory benefits are indicated.

The sense of heaviness turns into normal lightness. Pains leave the leg. After an experience of two or three days without the long worn elastic stocking the patient could not be induced to return to its troublesome use by any arguments whatever. The superiority of physiologic support over the artificial support is too marked to consider any other plan of treatment.

When the surface has broken down into an ulcer the antiseptic and healing ozone spray with the high frequency current speedily heals it by granulation. It is as unrivalled in this field as in many others. If an indurated margin surrounds the ulcer drive the blood through it by a few stimulating sparks.

PHLEBITIS.—This condition is an inflammation of a vein, marked by infiltration of its coats, and the formation of a thrombus of coagulated blood. There is swelling of the part, stiffness and pain, the vein takes on the state of a red cord, and a great deal of suffering attends some cases. It is a complication of a number of diseases, and if septic is often a troublesome matter.

To soothe the pain, hasten absorption of the inflammatory infiltration, disperse the clot, restore the vessels to normal and hasten the return of normal circulation and function, no remedy meets the indications with the completeness of an electric current with a sedative-alterative dose.

For its effect on metabolism a general electrification may be employed once daily. To this may be added the metabolic stimulus of a glass vacuum electrode treatment over the solar plexus. But for direct sedative action upon the tissues which contain the inflamed vein moisten in a hot soda bicarbonate solution a flat sponge-covered electrode the size of the palm, connect it to one terminal of the current and place it under the patient's back or sacrum. Moisten a sponge-covered hand electrode three inches in diameter, rub it with

lubricating soap and as hot as can be tolerated apply it to the affected part.

Select the dosage of current that corresponds most nearly to the fine induction current from a high tension coil with rapid interruptions and regulate the dosage from zero up to the intensity required to produce a perceptible and agreeable soothing, pain-relieving, and agreeable action upon the tissues.

With this dosage slowly and with gentle pressure-contact of the labile electrode set up the sedative action in all the tissues of the affected part. If it is the leg treat all that is necessary from the hip to the toe. Repeat twice daily till the acute suffering is controlled and then once daily until improvement permits the interval to be again lengthened.

FUNCTIONAL IRREGULARITIES AND ORGANIC DISEASES OF THE HEART.—The functional disturbances of the heart are nearly all reflex; the organic diseases are all some phase of inflammation, or the result of inflammation. There are no "curative" drugs for diseases of the heart. The cardiac tonics, of which digitalis is the type and chief, are rightly *emergency* remedies and of immense temporary value, but in long lasting disease the heart gets far beyond them.

In acute cardiac symptoms medicinal treatment is often adequate and it is mainly when drugs fail that physical remedies are permitted to accomplish what the drugs have failed to do.

In the principal diseases of the heart the most serious depressions are the secondary burdens placed upon it by the state of the vascular circulation, the blood, the various impairments of nutrition, excretion and secretion, and disease in other organs. In the treatment of the heart our first concern is to ease it of superfluous tax upon it so far as possible. This calls for regulation of habits, diet, digestive conditions, and whatever internal medication may be actually indicated, and in addition to these and most decisive of all, the physiologic actions of electric currents.

The high-frequency methods that may be employed are

described in full in the treatment of arterio-sclerosis. Refer to that section of this chapter and conduct the treatment accordingly. Continue treatment until the maximum of benefit is obtained and if relapses occur during the course of years resume the treatment until energy is again restored. Above all other precautions perhaps the most important for the cardiac invalid with advanced lesions is to avoid (by prudence) attacks of acute indigestion.

The writer has treated many cases of heart disease with electric currents and with marked benefits and no accidents, but refrains from citing his own cases here. As corroboration however it is interesting to note the report of a stranger who cannot be accused of bias in our favor.

In a case of heart disease reported by Sloan he says:

"The patient was 57 years of age and the blood-pressure, which I took several times to ensure accuracy, was so low as to be unique in my experience for that age. He had twelve high frequency treatments by general electrification. With the rise of the blood-pressure under the electric treatment the attacks of faintness ceased and the patient's health was completely restored."

"If the blood-pressure is already high, due to the high resistance of albuminuria or a weak heart, and when from long illness the heart weakness is great, as shown by a high pulse-rate which no medicine is able to reduce, the beneficial effect on the pulse-rate is sometimes striking.

"The following case is one which I have been able to watch and to gauge the progress of with exceptional care and accuracy. It was one of very slow recovery from uræmic convulsions. Coma had lasted for a week. Some days it seemed impossible for the patient to rally. At the end of ten weeks convalescence had made no perceptible progress. No medicine influenced the pulse-rate which remained between 96 and 102. At this stage we began the use of high frequency and stopped all medicines for ten days previous so as to be able to note the action of the current without error from other remedies.

"The effect on the pulse-rate was marked. It came down after the third electrification to 83, practically re-

maintaining at 85 thereafter. With the high pulse the blood-pressure had been running 180-200. Later, at a time when the patient's health was noted as "very good" the pulse was found to be 88 at 8 P.M. after rest, and the pressure 218."

"A very interesting case of intermittent heart came to me about the beginning of the present researches. The lady was 'run down,' nervous, and the heart seemed so weak and unstable that although I knew that her object in coming to me was to get electric treatment, I first decided to put her on a drug sedative-tonic, but at her next visit there was no change in the condition and the heart still missed about ten beats per minute.

"Auto-condensation was then given her for fifteen minutes, and during the following 90 seconds no intermission was detected. The number of missed beats per minute had decreased at her next visit to me four days later, and they again entirely disappeared after fifteen minutes of the current. Afterwards the pulse was always regular. Her temperature had been sub-normal. At the end of treatment it was normal."

The minor functional disturbances of the heart are practically all of the nature of reflex neuroses, for the heart is so faithful and enduring an organ that it scarcely has any primary disease. These nervous alterations of beat mostly annoy without crippling, but sometimes become a serious disability.

The most common (palpitation) has many causes—anæmic blood, gas in the stomach or intestines, coffee, tea and tobacco, nervous emotions, alarm, vasomotor irritability, etc. The rapid and feeble heart, the intermittent heart, the too slow heart, and the arrhythmic heart are other reflex faults. Sometimes the person is annoyed by a conscious pulsation which disturbs daily comfort and sleep at night. This is a vasomotor vagary.

A gentleman of hearty habit and with no apparent departure from good health, began to notice a conscious throbbing in his ear as soon as it lay on the pillow. It soon became a

nuisance. The high frequency current restored the vasomotor equilibrium and he hears no more of it.

The physician has only to turn to his text-books to observe the difficulty of selecting the right medical prescription for these functional derangements. They crop out in connection with other diseases and are very uncertain in their response to drug action.

In the course of years however we have observed that with rare exceptions they abate themselves while the person is undergoing electrical treatment for the primary disease, if there is one; or simply receiving general electrification without regard to diagnosis. We have seen many such. In one case of vasomotor disturbance the patient felt as if the heart gave a tumultuous leap and turned over with a great sense of "struggle" from six to ten times a minute if he was the least excited or hastily taxed. This speedily yielded to high potential treatment and the function became normal.

On the other hand, we have seen all the resources at our command, medical and physiologic, fail to make any impression on the action of the heart.

CHAPTER XXXII

SOME DISEASES OF THE NOSE, THROAT AND LUNGS

Treatment of Common Cold in the Head; Coryza; Acute Nasal Catarrh. Chronic Catarrh. Treatment of Hay Fever by High Frequency Currents. Inflammations of the Throat; Pharyngitis, Laryngitis, and Tonsillitis. Enlarged Tonsils. Tubercular Laryngitis. Bronchitis. Asthma. Pleurisy. Pneumonia. Treatment of Influenza-Grippe and its Complications from Onset to Quick Recovery.

As the mucous membrane is continuous from the nose to the bronchioles in the lungs, and inflammations in any part are in essence but one type of disease we have mainly to consider but one principle of curative treatment. This is the principle of nature in her own curative processes.

COMMON COLD IN THE HEAD; CORYZA; ACUTE NASAL CATARRH.—Apply a sedative-tonic high frequency dosage through a glass vacuum electrode over the forehead, root and sides of the nose, and especially through the nerve centres at the back of the head and upper spine. Press a finger to stop one nostril and snuff the ozone discharge forcibly up the other. Repeat in alternation until the passage clears and secretion dries.

This treatment at the onset of a fresh cold in the head will rapidly restore the normal physiological circulation and secretion. If nature lingers in the restorative process a second stimulus will help her finish it. If the condition has lasted several days when first treated it will require more treatment for the tissues have undergone more change. If the "cold" is two or three weeks old and resists drugs the high frequency stimulus will overcome the lagging inertia of repair and start nature into action. A few treatments will gradually restore to normal.

If the catarrh is chronic it makes some difference whether

it is a state of hypertrophic or atrophic rhinitis, but the same treatment applied with the necessary persistence will put the mucous membrane in as nearly a normal state as possible. It will do this better, far quicker, and more agreeably to the patient than any drug treatment known.

With the reasonable exception of the stage of invasion when simple camphor or rhinitis tablets serve so admirably to check a cold, nothing in medicine can for a moment compare with the physiological superiority of treatment by an electric current.

HAY FEVER.—Ordinarily, and barring nasal polypi or deformed turbinates, this is recurrent coryza with a neurotic and irritable background. It is as simply curable as any other form of cold in the head. And by the same principle, process, and physiologic action—the actions of nature plus an electrical stimulus.

The specific attack of hay asthma is produced by an irritant acting on the terminal nerve bulbs in the mucous membrane of the nose. The susceptibility is due to the presence in the nose of an area of vasomotor paralysis—a dilatation and congestion of the capillary vessels—with reflex irritability of the nerve-endings in this area. The predisposing cause back of this local condition is a neurasthenic and run-down state of the normal nerve tone. With the two factors removed by a simple high frequency tonic treatment to the general system, and to the nose as directed for common coryza, the prevention or cure of hay fever is a matter of extreme simplicity. Since we developed this plan of treatment about 1896 we do not recall a case of failure.

INFLAMMATIONS OF THE THROAT.—The pharynx, larynx, and tonsils are often the seat of acute and chronic inflammations. The pathology and principles of repair call for the same physiologic actions through the tissues. The method of applying the current must be adapted to the different anatomy of the parts. Instead of separating local disease of the various parts of the throat we can easily save space by treating them as one process.



PLATE XXIX.—For the inhalation of ozone properly mixed with atmospheric air, this simple method of the author is not surpassed by any. Stop one nostril with pressure of a finger tip while snuffing up the ozonized discharge through the other. Two or three minutes' inhalation will dry a running coryza and snuffles, open the passage in a nose stopped by swollen turbinates, soothe and heal the irritation of a "raw" mucous membrane, and allay the tendency to hay fever. This inhalation, deeply drawn into the lungs, is helpful in stimulating expectoration in bronchitis and drying the secretion, and assists the radical cure of all the curable forms. In phthisis it is also useful as an aid in lessening the cough and drying and eliminating the secretion. In cases of chronic nasal catarrh with fetid odor, first cleanse out the mucus by snuffing up a mild and warm salt solution just before inhaling the ozone. Read all that is said of ozone in this book. It is a very important adjunct to high frequency currents. In acute conditions repeat at short intervals.

If the inflammation has just commenced press the glass vacuum electrode deeply against the area of tenderness or soreness on one side of the neck and pass through the parts a sedative-tonic dosage until all tenderness is removed. Then repeat on the opposite side. Then make a general application with the same electrode over all the throat, down on the trachea if it is at all involved, and on the upper spinal nerve centres and base of brain, to restore the vasomotor tone. If the act of swallowing causes pain repeat the action with the electrode pressed on the painful spot, until swallowing becomes easy.

Make forced inhalations of the ozone discharge to end the treatment. Repeat daily. A few treatments (often one or two) usually suffice.

In more chronic cases treatment is the same but must be continued much longer, but the repair will be done quicker by electricity than by any other remedies.

In the case of hypertrophied and diseased tonsils refer to Chapter X and description of successful treatment by the high frequency escharotic spark. In cases of tubercular laryngitis the varied resources of electric currents offer practically the chief or only hope of the patient. This is work for the most skilled throat specialist and need not be treated here. In the absence of the specialist however the high frequency current as just described may be used, and in addition inhale the ozone discharge both through the nose and mouth.

Bronchitis; Pleurisy; Pneumonia.—By the next step of progress downward the inflammatory invasion may reach the bronchial tubes and be some form of "bronchitis," or may involve the lung substance and be "pneumonia," or affect the nervous mechanism as "asthma," or attack the serous membrane and be "pleurisy," etc. The simple inflammation may be invaded also by germs and then various complications arise, the most common being tuberculosis which is discussed in another chapter.

The drug treatment of the varying conditions through

their varying stages from onset to end is fraught with difficulty and imperfect results. But if nature has the vital energy she will handle the matter far better than drugs, and by means of high frequency currents we can assist nature with decisive energy in many cases. It is one of the most gratifying fields for the demonstration of physiologic therapy. One has only to read the first section of this book to realize how admirably nature can be supported in her restorative efforts here.

In the acute stage of any kind of inflammatory attack the principles of restorative action—the abatement of congestion, regulation of vasomotor function, or absorption of exudate and resolution of the process—do not differ in any part of the respiratory tract. Drugs may differ and be hard to select but the physiology of nature's therapeutics is *ever the same*—and electricity helps her.

Powder the skin to create dry resistance, or place a layer of cloth over the surface if still more intensity of dosage is required in some conditions. With the glass vacuum electrode and a counter-irritant dosage of high frequency treat all the surface of the chest, front and back, with the usual posturing of muscle-fibres if pain on motion exists, and also expansion and deflation of the lungs during part of the administration. If respiration is difficult work on the chest until it becomes free from distress. If there is soreness along the trachea apply the current until soreness ceases. If sharp pains exist in any situation remove them by passing the current through the tissues.

In a mild case with no temperature or a low temperature this treatment may be given with sufficient frequency once a day. In a more active inflammation it should be applied at least night and morning. But in a rapid rise of temperature and the onset of grave disease of any kind, as pneumonia, begin at once with thorough and sharp counter-irritation and redden all the skin and repeat several times at intervals of an hour until either the intensity of the



PLATE XXX.—Treatment of the Chest. Illustrating the author's correct principle of application in all forms of bronchitis, pneumonia, pleurisy, or pains aggravated by respiratory efforts. The legs should be drawn up to relax the abdomen. Have patient expand lungs forcibly (as in picture), and slowly empty them as much as possible during the treatment. This shifting of the relation of the ribs to internal tissues permits the current to reach the inner organs with effects that cannot be obtained in any other way. Ozone also reaches the lung cells and adds its antiseptic and healing action to the benefits of the current. Move the electrode over all the regions of thorax and abdomen. Use counter-irritant dosage when indicated.





PLATE XXXI.—Treatment of the Posterior Thorax. Illustrating the Author's correct principle of application to the back in any form of bronchitis, pneumonia, pleurisy, or pains aggravated by breathing. Have patient draw arms forward as shown, to remove the shoulder blades from over the region of the lungs as nearly as possible. Request her to alternately swell the lungs and flatten them as much as possible during treatment. This alters the relation of the ribs while the current acts and secures effects that cannot be equalled in any other way. Move the electrode over the affected regions to meet all the indications for treatment.

attack is modified or further applications for the day are useless.

Thereafter, throughout the disease be governed by conditions and indications, both as to methods, dosage, and frequency of treatment. But with this physiologic support of nerve tone, heart, eliminative functions, and vasomotors much of the gravity of the disease can be abated and recovery made far more decisive and complete.

ASTHMA.—Treatment of this troublesome affection follows the same plan as in ordinary bronchitis, with additional treatment of any reflex symptoms and an especial effort to discover and treat the cause of the asthma. Benefit is always apparent during treatment and temporary benefit may be very satisfactory, but the prognosis for permanent cure of any long lasting case of asthma is one to discuss with reserve. If high frequency abates the worst attacks it is worth something. When it does actually and for a long time prevent the paroxysms it is worth a lot to the relieved patient. The problem of asthma is still unsolved.

INFLUENZA-GRIPPE.—Here, however, electricity comes into its own. No other remedy can approach it in its mastery of all stages and all consequences of the gripe. Were we compelled to choose between the entire materia medica on the one hand and electricity on the other we would not hesitate an instant. In other writings we have set forth at length the various phases of this subject and the limits of this book confine us to narrow details.

The gripe is a periodic visitor and when it is with us it grips the attention of vast numbers of people for it is *pandemic*. It is a disease marked with peculiar and long lasting debilities, out of all proportion to the degree of primary attack; and out of the states of lowered vitality grow many and serious complications, from which untreated patients recover with remarkable slowness. The microbe of gripe is of a strange nature.

At the onset the whole organism should be supported by general electrification and by a general "tonic" applica-

tion to the nerve centres, spine, and great organs, solar plexus, etc., by means of the vacuum electrode. On the spine and chest make the dosage a sharp counter-irritant. Also give local treatment to meet all the symptomatic indications present.

In the period of invasion repeat this treatment every two hours until it produces marked abatement and then repeat three times a day until convalescence is established. A daily treatment will then carry the patient out of all risk of sequelæ and into complete and rapid restoration with none of the lingering debilities that annoy untreated victims.

During convalescence apply muscle-toning thick sparks to the main muscular groups of the body. Refer to directions under the head of any special complication that arises during the disease, and treat accordingly. The *lowered vitality* and *nervous depression* associated with the grippe make the physiologic invigoration of electricity of the utmost importance. And to the patient this fundamental value is wonderfully supplemented by its versatile ability to relieve a dozen or a score of annoying symptoms.

But in all these inflammatory diseases of the respiratory tract it is needful to consider the limitations of both electric currents and nature. The great thing that an electric stimulus can accomplish is the energizing of the processes of nature, rousing them so that they take up the task of restoring the normal and sound state.

This nature does gradually. It takes her some time. Neither nature nor electric currents nor drug remedies correct congestion and inflammation as water puts out fire. The part played by well-directed electricity may be likened to that of a lever that lifts up the fallen forces of nature and helps them to keep their feet till they regain their own normal strength. Read again the chapters of never-failing interest on life-phenomena and electricity, and also the chapters of physiologic actions. The scientific facts differ very widely from the charge of flamboyant ignorance that "electricity is the magic cure-all for everything from toe-

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ache to tuberculosis." Scientific conservatism is studious to learn but for a certain class of minds science has no existence at all. They draw upon their own imagination for their facts and by sheer assertion would dispute the multiplication table or Ohm's law. Mere laws of nature are nothing to such men.

CHAPTER XXXIII

TUBERCULOSIS AND ITS PREVENTABLE BEGINNINGS

The Principle of Correct Treatment. A Clinical Example of Ineffective Treatment. The Defects of Common Practice. Full Directions for Author's Treatment. Special Directions for Complications. Throat Symptoms. Respiratory Symptoms. Painful Symptoms. Pleurisy. Digestive Symptoms. Expectoration. Hemoptysis and Hemorrhage from the Lungs. Temperature, Non-Perspiring Skin, Hectic Fever and Night Sweats. Muscular Weakness, Muscular Pains and Soreness. Rapid Heart. Relapses. Acute Bronchitis. Disturbed Sleep. Tuberculous Ulcerations. Glands. Tuberculous Joint Conditions. Food, Rest, Exercise and Drug Adjuncts. Summary of Results from Physiologic Treatment. Author's Note on Light Rays and Sunshine for the Consumptive.

THE tidal wave of warfare against consumption is at its flood, and if practice equalled in results the amount of agitation and printer's ink deaths from tuberculosis should be getting rare. But the regular yearly quota of about 14,000¹ deaths from this cause in New York State keeps about the same.

The campaign has enlisted the nation. The history of medicine records no other activity so general, so widespread, and so *fallacious*. Extravagant schemes attract great sums of money and much exploitation from the press and political philanthropists; but actual *treatment travels in the time-worn rut* and patients die as they did of yore.

We have written extensively about this evil—the gross wrong done to victims, and the vicious fraud upon the public—and shall say little now and here.

The *nature* cure of tuberculosis in every case that gets

¹ The official publication of the New York State Department of Health gives the total deaths from all forms of tuberculosis for the year 1908, as 16,521 for the State, while only *one* person died of small-pox, which was once the scourge of mankind.

well is the *physiologic* cure. There is no curative medicine. Nor is there any virtue in denying treatment to consumptives and restricting them to the unaided and weakened powers of nature at the very time when her cry for help is the hope of succor, and if heeded would double her energies and rejoice her heart with success.

Nay, more: To intolerantly flaunt as the *only* treatment the supine measures of passive, deceptive and uncertain sanitation—the miscalled and but half complete “open air cure” — while violently flinging to one side with the scorn of the heel upon the serpent the lesson that even surgery is at last learning from the laboratory of nature—the lesson of physiologic *helps* to nature in the stress of disease—must some day bring down upon the head of those responsible the retribution they deserve.¹

For it is not a case of erring through needful ignorance. No one has excuse for present ignorance of the world-proved truths of physiologic therapy. The facts gathered in this book are ample demonstration that wide publicity has been given to both research and results. But when deaf ears refuse to hear and blind eyes refuse to see the things against which prejudice locks them up, it matters not if the song of *Israfeli* be in the appeal *the consumptive sick shall not have the benefits of any measure not authorised by the exponents of nature and open air*—not if patients die for want of them, as they *do*.

This is the logic of the politico-medical and morbid situation of the one-legged anti-tuberculosis warfare of a vain-glorious army of altruistic agitators—blessed of all men for

¹ We may consider with reason that cattle are outdoor—open air—fresh air—persons, and free from the taint of New York's east side tenements. Cows live “close to Nature,” near enough to it to please even a physical culturist or to qualify as patients with our leading specialists in the treatment of tuberculosis. Cows eat “Nature foods” and chew like Mr. Fletcher.

Therefore, it gives a jolt to the outdoor, open-air, nature-cure of tuberculosis to receive official information from the Department of Agriculture that 22 per cent of all the cattle examined in New York State in 1907 were tuberculous. *Why don't fresh air cows keep well?*

their noble words but lame as a hobbled horse in giving their words effect.

On the other hand, those who employ the physical helps to nature (of which electricity is the chief) have been woefully to blame and have fed the flames of criticism by their usually impotent methods. For example, in a high class clinic in Edinburgh, Scotland, "originally commenced chiefly as a study of the effects of high frequency currents in tuberculosis," and supplied with funds by a Carnegie endowment, we find a report on ten cases:

"With the intention of getting a good general and local effect the patients were given ten minutes on the auto-condensation couch, and then 5 to 10 minutes by spraying on the chest, anteriorly, posteriorly, and laterally.

"All benefited to some extent. No case showed signs of febrile reaction after the first few treatments, as has been recorded by some observers. There was a toning up of the nervous system, general increase in physical stamina, and mostly an increase in weight.

"The important point is that there never appeared any change in the physical signs in the lungs.¹ The method may therefore be regarded as a very useful adjunct with no specified effect on the tuberculosis, so far as these results show."

If the reader is interested in tuberculosis let him read this excerpt again and note the treatment. Here we have a physician, competent to be Chief of Clinic, and influencing the views of many who rely upon his investigations, flatly ignoring the primary physiologic basis of the respiratory act. He would treat paralysis with an ointment and a broken bone with advice—as forcibly as he has treated his ten cases of consumption with high frequency currents. And from his results he has drawn conclusions to delude others. How does he expect to alter the physical signs? By an administration that *never touches them?*

¹ Of the ten cases, one had six seances, four had ten, and three had twelve. Rare indeed is the case that could be so quickly cured of this disease.

And the profession has been full of this kind of incompetent treatment, and electricity bears the blame instead of the man with his fault behind it. He should not only acquire the proper apparatus to treat these cases but he also should acquire the knowledge to direct his treatment with a scientific meeting of *all* the indications—not merely a part of them.

In the Scotch clinic not a word is said about dosage, actions to be set up to meet individual indications, or *the adjustment of means to end*. His mental attitude toward treatment is wrong. Each patient is handed a “method,” but a *method* is not a medicinal dosage nor a physiologic action. Until this truth is embodied in practice small progress will be made.

But where was the Scotchman’s “method” faulty? Why did he fail? Why did the physical signs show no alteration under his auto-condensation and sprays?

Because he forgot that the respiratory act is a function of *muscular contractions*, and he entirely failed to make the muscular mechanism of respiration undergo strong, energizing, invigorating, and nutrition-building contractions.

The writer will undertake to do (what he has done in scores of cases) what the spray cannot do, namely, make a change in the physical signs in the lungs—and at will, and *in five minutes by the watch*. In a medium case, without asthmatic or emphysematous complication, the rales can be so changed, or dispersed from sites, by the shifting of the mucus that it may astonish a physician who sees it done; but contracting stimuli will do it as readily as furniture can be moved in a room.

Treatment.—Strip the patient to the waist and place him, or her, on the operating table; legs drawn up to relax the abdomen, a pad electrode under the dorsal region of the back, and a thin pillow under the head. Dry the skin of the trunk of the body with the usual toilet powder rubbed lightly over all the surface.

Connect the back electrode to the grounded terminal of the current and connect the “body” vacuum electrode to the

other terminal. Warm the bulb, cut out the current, apply the bulb to the chest, regulate the dosage to a warming energy, and begin at the throat.

Make the current set up a sedative-tonic action upon all the tissues of this part, allaying irritation, starting the secretory glands, and improving the nutrient blood-supply through the tissues.

Then move the electrode down on the chest. Have the patient fill the lungs as full of air as possible, swelling out the thorax to the fullest extent, and in alternation with forced *inspiration* make forced *expiration* and press all the air out of the lungs that can be got out. During these muscular acts of the patient apply the ozone-carrying, tonic and nutritional stimulus of the current to all the anterior tissues of the chest. Make the application extend to each side down to the table, and especially include the axillary regions. Mark how the patient will gain increased respiratory capacity during this treatment. It is of great interest to note the voluntary expressions of their gain.

Next apply to the lower portion of the same surface the directions given in Chapter XXI covering the digestive functions. No matter whether the patient has marked gastric deficiency or not, treat the digestive organs exactly as if he had. They need every bit of aid we can give them.

Now turn the patient over, have the arms drawn up over the head to take the shoulder-blades out from over the lungs, and put the pad electrode under the solar plexus. Powder the skin. With the same vacuum electrode and a strongly tonic dosage have the respiratory exercises repeated while the current is made to set up a nutritional stimulus through all the parts over the lungs. With normal respiration then finish the spine with a refreshing tonic application to all the nerve centres and the kidneys.

In these cases, if the skin is pale, redden it with a counter-irritant dosage. Drive the blood, dilate the capillaries and improve the *surface circulation*. It is important.

Either at the close of the same seance, or in alternation

with the foregoing portion of the treatment, sit the patient up, and with fully expanded chest contract each set of respiratory muscles and increase their power and nutrition by thick, muscle-toning, nutritional sparks—the most active stimulus to metabolism of muscle fibres that medicine possesses.

Close each seance with a restful and refreshing spray to the head, or a vacuum electrode sedative dosage to the forehead.

Along with the foregoing it is useful to have the patient make forced inhalations of the ozone discharge from the tip of the vacuum electrode, pressing a finger upon one nostril to close it while inhaling up the other.

While detailed directions require many words, yet the experienced physician will rapidly and effectively treat many complications at the same time he is producing the benefits of the above described general treatments. Some of these symptoms and complications we shall now consider.

Throat Symptoms.—Treat the cough, dryness of throat, thirst, hacking irritation, hoarseness when it exists, and all distress or pain referring to the throat exactly as directed in Chapter XVIII under the head of *Cough*. Also see Instruction Plate No. XVI.

The physiological improvement of the tissues by reason of the better blood supply and increased nutritive activity of metabolism is altogether in a different class from the opiate cough mixtures and expectorants in routine use. The action is curative when the disease is within the curative stage. We have abated coughs and gradually restored the throat to normal comfort in cases that had derived no relief from heroin and various other sedatives before coming to us. The contrast between the downward influence of opiates and the upward influence of tonic-nutritional electricity is one of the advantages given to the patient by high frequency treatment.

Respiratory Symptoms.—Treatment of oppression in breathing, shortness of breath, diminished ability to take

full breaths, too rapid respiration, impaired control of expiration, and all respiratory symptoms, is embraced in directions given at the beginning of this subject in this chapter. For the removal of soreness in the chest or any kind of pain and tenderness, see "painful symptoms" below. The directions cover all chest pains.

In ordinary cases without the crippling disabilities of asthma and emphysema we are often able to make a reinforcement of fifty per cent to nature's energy at the first electrical treatment. To send a patient outdoors to breathe air when the capacity to work the muscles of respiration is reduced one-half, and do nothing to tone up the muscular breathing capacity (the vital factor in a cure) is one of the ironies solemnly insisted on by open-air exclusivists, who seem to be quite oblivious to the ridiculous. They have no sense of humor. We prefer to send the patient out into the air to breathe with his respiratory ability greatly improved by one, two, or three rational electrical administrations. A patient can do better building-up when he can take in a lot more oxygen.

Painful Symptoms.—The pleuritic pains, the sharp cutting pains that often keep the patient on shallow breaths because deep breathing hurts, are easily and permanently removed by a brief counter-irritant application of electricity.

Posture the muscles so as to set up any pain that may be caused by muscular movement, and also have the patient take the kind of a breath that hurts, and while the pain is being thus aggravated apply the sharply irritant but sedative dosage of current. Repeat until all pain disappears and remains away.

This application is swift, almost as swift as a knife; and is often a relief to an acute and recent pleuritic pain within the space of a few seconds. In an old adhesion and any obstinate case, no matter how obstinate, simply persevere and if relief is obtained temporarily it can be made permanent by working at it. In clinics for the poor nothing curative is done for these distressing pains.

Dry Pleurisy.—This complication is removed by the treatment described for pains on respiration. The removal of this single complication alone often releases the patient from one of his most crippling disabilities in the matter of breathing—the matter of the intake of oxygen. Persist in the treatment until full benefit is obtained.

Scarcely anything save food can be more important to a consumptive, yet as respects these reliefs and others still to be mentioned the routine treatment given patients at the much-vaunted municipal tuberculosis clinics is farcical and vain. We know it because we have personally witnessed it.

Digestive Symptoms.—Treat loss of appetite, diminished appetite, disgust for food, nausea after eating, dyspepsia, and all digestive disturbances as directed in Chapter XXI. This includes constipation and diarrhoea and derangements of the liver.

In advanced cases these measures, and all others, may fail to enable the patient to eat and relish food to the desired extent, but in many earlier cases we have seen appetite restored, relish and ability to eat and digest, and a complete revolution in the nutritive condition produced by high frequency treatment in patients coming to us after drug tonics had entirely failed to create an appetite.

Expectoration.—The general treatment of the chest as directed at the head of this part of this chapter acts upon the secretory cells of the lungs, thins a thick and tenacious secretion, frees it from the air-passages, enables it to be easily coughed up, lessens the amount of secretion and gradually dries it to nearly the normal, or to the normal serous secretion of health, and the morbid expectoration ceases. The purulent discharge of advanced incurable cases is often greatly reduced and the drainage of the lungs made much easier for the patient.

The extent to which the tax of difficult expectoration can be abated by the high frequency current exceeds by far the effects of any drugs and the benefits are a physiological gain. Expectorants in long continued use are the reverse. They

degenerate into an abuse. The patient cannot stop them but they have no curative action.

Hemoptysis and Hemorrhage.—Spitting of blood usually ceases to be a symptom under the nutritional influence of the high frequency current upon the blood vessels of the lungs. Treatment is covered by the general treatment of the chest described above.

We have seen a single treatment suspend hemoptysis in a case that had been spitting blood for a week. In all favorable cases the symptom yields early in the course of treatment. Even active hemorrhages are controlled by the same vasomotor-tonic action. The stimulus contracts down the relaxed capillaries and small vessels that bleed easily, and they stop bleeding.

We have never seen hemoptysis or hemorrhage of any degree caused by any electrical treatment we have ever given. The action has been the reverse. And this has been true even when the vessels were bleeding as treatment was begun. In one marked case the patient had 14 active hemorrhages in the two months previous to coming to the writer. The day of his first appointment he was stopped at his station by a profuse hemorrhage and went home at once. He came the next day for his first visit and in the two following months in which he was under our high frequency treatment he had but a single attack—and a friend informed us that on that occasion he had been out on a spree.

Temperature, Burning, Non-Perspiring Skin, Night Sweats, Hectic Fever.—All the symptoms abate, so far as it is possible to abate them, under the treatments described above for the general condition and other symptoms. But to aid in the elimination of toxins which produce these symptoms we have obtained additional and great help from an eliminating electric light cabinet bath in the apparatus devised by the author—one containing our special and original improvements adapting it to the treatment of these cases.

Muscular Weakness, Muscular Pains, and Soreness.—

Treat muscular disabilities which interfere with the patient's exercise and sometimes prevent walking altogether, or cause such fatigue as to make it unwise, by means of the muscle-toning, thick, and nutrition-promoting spark. One or two treatments will work a revolution in the patient's muscular energy but keep up the treatment so long as there remains benefit yet to be given. Many cases are troubled with their muscles. Advocates of open-air cures leave them to nature and an *unaided* restoration. An electric current *improves the muscular function decisively and at once*. Which is the best for the patient? The patient dragging his difficult and way-worn limbs to the usual tuberculosis clinic has nothing done for his muscles. He simply drags them away again. The clinic is a travesty.

Rapid Heart Action.—The high frequency improvement of the blood (for the stimulus to normal heart action is the circulation of normal blood in its substance) and the elimination of toxins, as well as the general nutritional and nerve-tonic improvements promoted by the treatment may regulate the heart to a better rate. But if not, then drugs should be given to rest the heart. And if all fail, as they may fail, put the patient to bed for a time if the condition requires it. The same is true of high temperature.

Relapses.—Under the "hygienic" system, which is practically the same as no real treatment at all, relapses are prone to occur in some stages of tuberculosis. Under decisive and thorough treatment as taught in this chapter we seldom meet a serious or more than merely transitory "relapse." Treat them as met, according to the nature of the acute symptoms. One likely to arise is acute bronchitis. This is effectively treated by the same means described under general treatment of the chest, and requires only more *frequent* applications until the attack is abated.

In cases of the "improved" class, recurrent treatment for a period of each year is advisable without regard to relapse, to maintain as nearly as possible the maximum of improvement and hence delay and retard the down grade.

Sleep.—We have not given directions for any special treatment of disturbed sleep, as the relief from cough and release from the causes which prevent a proper amount of sleep soon enable the patient to secure it as a rule.

Tuberculous Ulcerations.—Add a high frequency ozone spray to the ordinary treatment and care of such lesions and rapid healing will be promoted in all cases open to reach of the discharge.

Tuberculous Glands.—If enlarged without redness, tenderness or sign of active inflammation, stimulate absorption and nutrition by a low potential "wave current" passed directly through the tissues, one electrode covering the gland and the other so situated as to direct the current as required. This application reduces the size of the gland very rapidly, tones up the tissues and their metabolism, and feeds the cells with a better blood supply.

If the gland is acutely tender and inflamed use a sedative spray. This will not only allay the inflammation but will promote absorption and restoration to normal. Later, the glass vacuum discharge should be applied directly on the gland. If some enlargement remains use the author's wave current as directed above.

Tuberculous Joints, Bursitis, and Exudations.—Treat on the same principles as glands. If acutely inflamed begin with the sedative spray. If chronic and cold, use counter-irritation when indicated; the author's wave current when indicated, and treat as any simple joint condition of similar gross pathology without regard to tuberculosis. The results of rightly directed high frequency treatment are often as rapid and as curative as if the bacillus was never present. With inflammation allayed, exudates absorbed, cellular functions restored, the blood ozonized and improved, nerve and cell tone re-established and nutritive exchanges once more put on a physiologic basis, nature will take care of the rest.

In any of these local complications we may meet indications for the muscle-toning and nutritional stimulus of

the high potential spark, and its great value must never be forgotten, even if not mentioned in every page of our directions. In its place it is the unrivalled *intensity* of action. Keep it in mind in case of need.

Food, Rest and Exercise.—The regulation of these becomes almost automatic under the benefits of high frequency treatment, in cases this side of the hopeless stage. In early cases there is nothing to say at all, for the patient so rapidly improves that he may simply follow the rules of health.

But when the more advanced patient must perforce *rest* under the inadequate open-air "system" (for he cannot exercise without injurious fatigue), we can give his entire body an invigorating and strengthening exercise, in five minutes, with the heart at rest and with no tax upon the motor centres of the brain. Faddists whose prejudices refuse patients these benefits wrong the victims of their unscientific attitude towards all remedies other than open air and food five times a day, whether the patient can assimilate it or not.

Drugs.—If any internal medication can meet any indication present in a given case with benefit to the patient *let him have it*. Theories that because drugs cannot cure tuberculosis they must be denied the consumptive are the expression of folly. In many cases the symptomatic help of medicine is grateful to the patient and should be part of the treatment when the help is genuine.

There are other complications and many difficulties to overcome in the long career of pulmonary tuberculosis, and we have other resources in physical agents to help combat them when met. But a small book cannot hold all the teachings of experience or all the reasons on which our statements are based. An adequate discussion of this disease alone would fill a book of much greater size. Some day we may write it.¹

¹ Those interested will find a section of about ninety pages on diseases of the heart and lungs in a book entitled, "Electricity in Health and Disease," by Dr. S. H. Monell, published in 1907.

The vital need to rescue victims and safeguard the community is the development of a universal habit of *early* treatment for those who have tuberculosis, and the repair of any state of lowered tissue-resistance in all others *before* they *get* tuberculosis. In this way it would be entirely "curable and preventable" and would disappear in a few years.

The principle of protection is the same as in small pox. Vaccination is protective in advance, and modifies the severity when done in the period of incubation of the disease, but of what curative value is it when the man is full of pustules? It is exactly so with physiologic remedies in tuberculosis. The public should be educated to understand this undodgeable truth.

Physiologic remedies and the directions we have given for treatment are our rational *addition* to all other beneficial measures of any kind whatsoever that will do the patient good. We use all the good in the "out-door system" and *add* the good help of physiologic stimuli to every effort of nature.

The limits of space do not permit us to cite cases or argue about results, and a brief summary of facts will now close this chapter. But before summarizing it should be noted by all readers that what follows is not a series of "claims" of uncertain value and the offspring of "enthusiasm," but is a statement of actual work done in the regular course of many years of practice as a physician, with results proved over and over again in a large number of cases.

Summary.—This plan of competent and complete treatment is superior to the incomplete "hygienic" and "out-door" system which it covers and surpasses. It is equally possible to apply to every case of tuberculosis, in any stage and however complicated, and can be used by all physicians who have this class of practice and who will acquire the skill.

Physiologic remedies externally applied intensify and concentrate the curative energies of nature into the most

active and efficient medicinal dosage. They can be employed in conjunction with "climate," fresh air, diet, hygiene, drugs, and every other beneficial means prescribed for a given patient and will reinforce the actions of all other agencies for good. They conflict with none. They can be added to the routines of sanatoria, hospitals and clinics, and constitute the most *decisive link* in the chain of treatment. Without them the best sanatoria methods limp like a ship with a broken rudder, and the boasted tuberculosis clinics of New York are an empty show.

They are safe, effective within the limitations of human skill, free from disturbing actions, agreeable to patients, harmless in hands acquainted with the technics, and meet a great number of indications many of which otherwise remain *untreated*.

In states of the disease now recognized as "curable" they are the most decisive means by which to arrest the progress of tubercle deposit and most quickly restore the patient to the best obtainable degree of health. In the "incipient" stage and especially in the important "predisposing states" this plan of thorough treatment can be made to restore sound health in a small fraction of the time required by the "out-door system" alone, and without the oft harassing uncertainties about the permanency of the result (or the extent of benefit) that cluster around that popular mockery of true therapeutics.

When employed too late to arrest progress of the disease more than to slow its pace the plan here taught for complete treatment is the most decisive and satisfactory means of relieving symptoms and affording comfort to the incurable patient. Between the two stages of "early" and "late" tuberculosis this plan will most efficiently uplift the patient's energies, maintain freedom from suffering and strength to work, prolong life, and prevent or control relapses.

No consumptive patient should accept any treatment anywhere, either at home, or in a tent camp, sanatorium, hospital or clinic, which does not include the decisive physio-

logic actions of selected physical remedies. Any physician, hospital, or institution devoted to the treatment of pulmonary tuberculosis without adding the competent administration of approved physiologic remedies betrays the trust of patients, disregards their welfare, and to the extent of neglect of known resources of superior benefit, is guilty of malpractice.

Author's Note on Light Rays and Sunshine for the Consumptive.—As a missionary to impart information to those who need it, a word on the use of electric light (or sun light) in treating tuberculosis is unavoidable. In 1907–8 a great scare arose in certain editorial sanctums against “sunshine for the tuberculous.” A sensational army surgeon, obviously with no clinical experience in “light-therapy” wrote a one-sided book on the “Injurious Effects of Tropical Light on the White Man.”

This lurid structure built on false premises by ignorance of the basic facts alarmed a score of editors of the lay press and threw consternation into the columns of some medical journals—all of which would have been spared tuberculous readers if a little research into photo-therapy had been made *first*. For five pages of running comment one medical editor reached the acme of hysterics and arraigned “phthisio-therapeutists of supposed authority” for giving “dreadful advice” to the victims of this disease.

We stick to our confidence in the benefits of light rays in the treatment of very many diseases, among which is consumption, for the results are indisputably proved. Why, therefore, the scare? Why the rampant assertions in type that “sunshine” is harmful—dreadful—fatal? Let us see.

Heat and light are not the *same* thing. Every one knows that heat is often a useful remedy in sickness, but it needs regulating. In a hot bath we do not aim to scald a baby with convulsions.

Light is also a great physical remedy in sickness, a remedy of giant powers and widely various resources, as one may learn by reading the section on the Medical Uses of

Light in our "Pictorial system of instruction for Physicians" published in 1902. In applying curative light rays we do not regardlessly *over-dose* the heat rays, for heat treatment is quite a different thing—a thing of different physiological actions in the tissues. *Unstinted* heat is not a medical dose.

Now the simple truth is that the factor in hot summer sunshine (associated with light rays but separable from them) which makes exposure depressing is "radiant heat." And the part of the body which is most depressed by direct exposure is the *head*—the delicate brain cells and nerve centres. Medical treatment by light rays protects the head and exposes only the tissues that need treatment. But on any part of the body a given intensity of light (as measured in candle-power) will be tonic, nutritional, and a benefit when properly separated from excess of heat, or may be depressing and even sickening if the heat is in excess. It is all a matter of *dosage*, as it is with every medical agent whether heat, light, or drug. Where would medical practice lead us if we ignored dosage in our prescriptions?

The radiant heat from the sun is as useful to the world as its light, but in physiologic actions they are different—very. Also, radiations of "radiant heat" penetrate the human tissues in some measure almost as freely as x-rays do. We are porous to them.

But cover your eyes with a handkerchief and you cannot see to read. Light rays are cut out. Clothing cuts out light rays. We could not read print through a hat. White men in summer, and in the depressing summers of the tropics, wear clothes on their body and a helmet on their head. Therefore, most of the sun's *light-rays* are barred out by these protections. If the light radiations are thus kept out of the tissues (as they are to a great extent) what becomes of the theory of theorists who blame *light* alone for the depressions of excessive radiant *heat*?

But the *heat* radiations from the sun penetrate surface

coverings and the tissues, or they so heat the atmosphere that the depressions of excessive heat are felt. The agent that penetrates and disturbs the circulation and raises the temperature of the blood is the one that does the damage and not the agent that is mainly barred out. And in the tropics the humidity is often high, another depressing factor.

The extensive tests of Dr. Bokemeyer showed that persons subject to mixed light and heat rays, with an excess of *heat*, had pulse changes ranging from twenty-five to fifty-nine extra beats per minute, and an increase in blood temperature of from 1.9 F. to 3.3 F. But *when the heat rays were greatly reduced the same amount of light rays had no disturbing effects.*

With an excess of the ordinary conducted (not radiant) heat in a Turkish bath a man may become depressed and faint, but his sense of comfort is usually restored at once by wrapping a cold wet towel around his head. This illustrates the relation of exposure of the head to any excess of heat. In fevers the same means of relief is grateful. "Sunbaths" in temperate climates with an agreeable mixture of radiant heat—with the head protected from excess when the whole body cannot be—are as beneficial to-day as they were before an army surgeon wrote so many things that he didn't know. And still, among the greatest remedies, is *electric light*.

On November 29th, 1893, Prof. W. H. Thomson, M.D., LL.D., delivered the Anniversary Discourse before the New York Academy of Medicine. Part of it was a review of the world's knowledge concerning tuberculosis, and the following reference to *light* occurred in it:

"Tubercle bacilli live in dried sputum for ten months, they resist many germicides and are not destroyed by the gastric juice. Nevertheless, *they are extremely susceptible to direct sunlight, which will kill them in a few minutes, and even in the diffused light of a room with good windows they will die in seven days.*"

Since that pioneer date the greater part of the development of electro-phototherapy has taken place. Invention has evolved appliances for scientific control, dosage, and direction of all the physical agents by means of which it is now possible to reinforce nature in her efforts to restore the sound state. With awakening intelligence on the part of a profession far behind the other advances of the world the stumbling blocks of prejudice should be cleared from the path of progress and a new era dawn in therapeutics.

CHAPTER XXXIV

THE REFORM OF MODERN SURGERY

Nature is the Healer and High Frequency Helps. Its Tonic Action Before and After Operations. The Great Stimulus to Functional Repair. The Aid to Quick Recovery. Relief of Symptoms Left After Operations. Treatment of Sprains and Bruises. Synovitis. Dislocations and Fractures. Non-Union of Bones. Healing by Granulation. Suppuration. Irritable Tissues. Neuralgic Pains in Scar Tissue. Hyperæmia to Induce Healing. Directions for Methods. The Physiologic Era of Surgery.

So many cases for the surgeon (and measures which he must employ) are associated with impairments of function before the patient is well that scarcely anywhere in the practice of medicine is the high frequency current more useful or necessary.

The surgeon removes diseased tissue and puts injured and diseased parts in position to heal, yet although asepsis and antiseptics clear bacteria from the path of nature *none* of the mechanical work of surgery is healing or curative in itself. From granulation to bony union and the restoration of function, *nature*, either unassisted or still better by assistance, does her own healing and curing. Not a bit of it can the knife, the splendid technics, or precautions do.

But high frequency currents of sedative-tonic-alterative-nutrition-stimulating and function-improving energy can help enormously. It is conservative to say that if the full resources of electricity were skilfully employed in the preparation of patients before operation and for their completest recovery afterward, the average of patients would have a clear gift of thirty per cent of their time from first to last, would be spared tedium, delay and suffering beyond compute, and in thousands of cases would reach a far higher

rung in their climb up the ladder to health. That mortality would be reduced cannot be doubted.

Take the first stage of preparation: If troublesome or wearing symptoms are present (especially if nervous symptoms or pain), high frequency sedation or other indicated actions can relieve them with a general benefit in addition.

If the patient is much below par, especially if aged or with bad kidneys and heart, the tonic stimulus of high frequency currents cannot be withheld without grave responsibility. Simply read again the physiologic actions upon metabolism and this becomes too obvious for discussion.

Immediately after the operation comes the recovery from anæsthesia and the surgical shock to the nerve centres. A tedious day, or two, or more awaits the patient. Soreness, extreme weakness, restless irritability or pains may be present and drug sedatives, while easy to give, are no tonics and not flawless helps. They have some drawbacks.

But as the sun and the fresh breeze of morn may sweep out the mist from a pocket in the valley, so swiftly and with nature's own uplift can the ozone and the tonic of a high frequency current sweep the lingering ether from the brain centres and the effects of shock from the nerve cells. It is such exquisite action, so beautiful and so life-bestowing to the patient in the critical first days of many a major operation that its universal use should be the rule.

The rapidity of *convalescence* from surgical operations for injury and disease can be greatly aided by the help of high frequency currents. Traumatism, immobilization of a part or all of the body, non-use of muscles or of functions, cicatricial formation and possibly contractures, tend to disturb the activity and the balance of metabolic exchanges within the tissues. Pains, neuralgias in wounds, inaction of the bowels, lameness and stiffness or shortening of muscles, impairments of substance and of energy, all more or less enter into the difficult cases and do much to cloud the aftermath of brilliant and successful surgery. High frequency technics can remove them.

And if there are no symptoms at all but lack of strength, high frequency tonic and nutritional actions can help to restore this much faster than rest and food alone, in the majority of cases.

For these purposes the modern versatile high frequency electrical apparatus is like a chest of tools from which we can pick the instrument required to do the special work. In the most profound prostrations the new condensation pads will make *general electrification* available to all. For sedation to nerves the tranquilizing-tonic discharge through the glass vacuum electrode can be made the veritable Balm of Gilead to distressed tissues. To correct the lost functions of muscles after dislocation, fracture, or immobilization and non-use the modern apparatus gives us the means of securing the contractive effects of static induced and faradic currents, as well as the powerful muscle-toning, nutrition-stimulating thick spark.

If the liver, spleen, pancreas, kidneys, heart, lungs, or alimentary canal needs assistance the right dosage and the action required may be applied accordingly. The methods have so often been described in other chapters that they need hardly be repeated here. Special directions will, however, be given for a few surgical conditions.

SPRAINS AND CONTUSIONS.—A medical "authority" with the imprint of 1908 directs the treatment of a sprain by "hot or cold applications and bandaging." Think of it! Medical students looking forward to tortured patients may well ask, "When is an 'authority' not an authority?"

As a type let us take a sprained ankle. The thing to do *at once* is to get the circulation going and keep it going through the wrenched or ruptured tissues. Instantly, without the delay of a moment if it can be avoided, get the foot deep into hot water. Gradually add hotter water and still hotter, and for at least a half-hour keep the capillaries thus dilated and the resistance to the circulation reduced to the lowest point. This act alone, done at once, will cut off fifty per cent of the consequences of not doing it.



PLATE XXXII.—A Sprained Ankle. Illustrating the high frequency treatment of a sprain or other injury of the ankle joint. Apply a sedative or counter-irritant dosage according to the condition of the tissues at the time. "Posture" and move the joint and put weight of the body on it in chronic states when restoring functions of the muscle fibres. Cover the part with a resistance cloth when a sharp irritant dosage is required.

But whether this is done or not, the next thing in immediate importance is the tone-restoring and vasomotor stimulus of the high frequency current. Apply it thoroughly around the joint with the glass vacuum electrode until the pain and swelling abate and the circulation is got under control. In this acute stage the dosage should be sedative-tonic. Repeat every two hours in a severe case, or twice the first day and then once a day in a mild case.

But if the sprain occurred some time previously and had no proper *immediate* treatment the high frequency dosage will depend on the state of the tissues. If the joint is hot and throbbing apply the same treatment with the sedative dose of current. If the skin is acutely tender from active inflammation do not use a contact electrode but subdue the heat, tenderness and swelling with a sedative spray discharge. This is the supreme comfort in all cases with intolerance of the surface to touch. It comforts and restores.

If the joint is cold and the sprain chronic then the dosage must be rubefacient and counter-irritant. Apply the current through a dry resistance—two or more layers of broad-cloth, as directed in the previous section. The treatment of bruises follows the same principles and dosage.

Nothing else is required in the majority of simple cases. Not even a bandage. Not even rest. We have taken cases hobbled for months by the non-curing methods of surgical routine, given them a single treatment, seen them walk off half well, and return still further improved in the interval of a day; and in from two to six treatments feel no reminder of the injury. The remedy is prompt and sure.

SYNOVITIS, ACUTE AND CHRONIC.—Treat all synovial inflammations with the high frequency current exactly the same as directed for sprains. Meet the indications with the proper dosage—sedative spray with surface intolerance to touch, and counter-irritant dosage in chronic conditions. Contractions by the thick spark or low potential current to restore muscles to normal after inflammation ceases.

POST-DISLOCATION AND POST-FRACTURE TREATMENT.—Effusions into tissues or joints will be quickly absorbed, the debris of injury removed, swellings and pain reduced, and normal functionation most speedily resumed, if all these cases have the aid of high frequency alterative and tonic administrations.

The methods are the same as for all traumatisms. Nature does not have a different remedy for every new location or kind of injury. Her processes of restoration are few and in the use of the high frequency current we simply lend her a helping hand and she does the internal work herself in her own way. *But our external stimulus may be vital to her success.* It often is.

NON-UNION OF BONES.—When bony union fails to take place make certain that the surfaces are in position to unite and free from interposing tissues. Then stimulate the nutritive activity of the parts by high frequency counter-irritation over the seat of injury for local effects, and over the spinal centres and digestive organs for general nutritional tonic action. The result should show in normal osseous healing. In old subjects or when the prognosis for union is in any doubt this precaution is worth while anyway. It will infallibly do some good and cannot do any harm.

In all these cases the dressings may be made with a view to permit treatment. Muslin bandages require regulation of the dosage, but treatment can be made through them, ordinarily. A thick plaster cast is a barrier to treatment unless a *fenestrum* is made for the purpose.

HEALING BY GRANULATION.—When this does not take place properly, or when it is progressing too slowly, the rapid and perfect process can be remarkably helped by a few daily applications of high frequency current. An ozone stimulating spray on the lesion, a few mild muscle-contracting sparks on the tissues surrounding it to hurry the capillary circulation and bring fresh blood to the parts, and a little frictional stimulus to the spinal centres, will work wonders in a few days.

SUPPURATION.—When pus is observed an ozone spray is the most thorough antiseptic and healing application that can be made. None of the antiseptic solutions such as merc. corr., creolin, carbolic acid, formaldehyde, or even peroxide of hydrogen approach its effects. For it not only is the active peroxide of hydrogen in a superior form but it often far surpasses mere surface solutions by its deep penetration and the tonic nutrition-stimulus to healing that it carries with it. To be at all appreciated its action should be seen.

IRRITABLE TISSUES.—Sometimes tissues betray an excess of irritability, which is not easily subdued. A high frequency sedative spray will do it promptly in ordinary cases.

NEURALGIC PAIN IN SCAR TISSUE.—We have removed a severe neuralgic pain from the wound of an appendix operation which had annoyed the patient for a year, and by a single treatment. Treatment of pains of this class by anodynes or by the advice that they will wear away in time should give place to proper and immediate relief by high frequency currents. Employ the methods described in our chapter on neuralgia. Unless a nerve filament is compressed by cicatricial tissue so that it must be cut out, electricity will be promptly curative.

HYPERÆMIA TO INDUCE HEALING.—Bier focussed attention upon the help to the healing process of an increased blood-supply. From carbuncles to gonorrhœal urethritis and gonorrhœal rheumatism hundreds of cases have been reported in evidence of its value. As a general principle, in all cases of anæmic tissues, it must necessarily do good.

High frequency currents furnish one of the most effective means of producing healing hyperæmia. The application of a stimulating dosage of current through a glass vacuum electrode is one means. It can be applied to almost every surface. In surgical wounds it can be applied directly through the first layers of dressing and the dressing can be completed after it.

The application of the lower potential wave current through a joint, or any local part, with two contact elec-

trodes, is a second efficient means of increasing the blood supply and promoting healing.

A fitting close to this book is furnished by an extract from a paper lately read before the New York Academy of Medicine by a representative surgeon, which meets our eye as we reach this page.

"A new epoch in surgery has been opened by the object lesson of conserving the patient's natural resistance in cases of appendicitis. The prevailing era the world over has been *pathologic*, the dominant idea of which has been to prevent infection in wounds and remove the products of infection by our art. But in appendicitis this plan has not worked out. The rubber glove upset the whole train of the system, and the sun is now to shine on what is perhaps the most fertile area ever exposed to light.

"The rubber glove necessitates slow work, long incisions, and guidance of the eye. These are circumstances of damage to the resistance of the tissues. Our faces are now turned toward Metchnikoff and Wright, with their descriptions of phagocytes and opsonins, and of the natural protective forces of the patient.

"*We are at the dawn of the physiologic era in surgery.* We are to conserve the natural resistance of the patient and turn him over to his phagocytes and opsonins as helpfully as we can. We are to leave the patient in his best possible condition for manufacturing phagocytes and opsonins, through the shortest possible method of anæsthesia and the least degree of surgery that will suffice to turn the tide of battle between *bacterium* and *leucocyte*.

"That is the new principle—turning the tide of battle only, and leaving the patient *with his physiology as nearly intact as possible*.

"The first object lesson in support of the new idea was furnished by the physician who did not operate for appendicitis and whose patients *recovered*, sometimes even though they had pus in the peritoneal cavity. These cases required explanation, and now we have the explanation. The patients attended to the bacteria and the products of infection themselves!

"Our surgery of the pathologic and rubber glove era had

a tendency to damage the patient to such an extent that he could not destroy his own bacteria and products of infection. These twain, the results of non-operative treatment and the results of operation without the details of former technic, *are lessons sufficient for a basis of the coming art of the physiologic era in surgery.*"

Here at last we seem to have the tardy recognition of the surgeon, arrived at by way of Europe and through the medium of a Greek word, of the principles fought for by more than two generations of plain, common sense, home-born American physicians, striving to carry to their colleagues the message of physiologic therapy; but till now it has been like the voice of John crying unheeded in the wilderness.

Every book the present author has written advocates this same principle, and this is his *seventh* published book in the last twelve years. *Opsonins* however may do what other language has almost failed to do in the way of arousing the profession to nature's methods. And if rational physiologic therapeutics is at last to be added to surgery the medical millennium may be expected in a nearer century, *for medicine follows where surgery leads.*

Only in its final, vital field of *therapeutics* does Medicine lay down its claims to science and abandon even the saving grace of common sense. "The fight for pure science is the fight for truth, the pursuit of knowledge no matter where it leads." Pure science *is truth*. It cannot divide on party lines or solve its questions by a rising vote.

In Medicine the study of *anatomy* is conducted as a pure science. The anatomist does not settle the length of a man's legs by debate or his personal viewpoint; he measures them.

In Medicine the study of *physiology* is pure science, the pursuit of knowledge no matter where it leads. Our laboratories of research do not divide on questions of experimental test; they test them and seek to unify results.

Bacteriology is the search for truth. We have yet to see

an investigator of germs set up his "say so," or partisan belief, or arbitrary opinion, as a standard of practice.

Diagnosis is at least pursued in the spirit of pure science with the intent to find out what ails the patient, even though in this field the individual unit often pursues his knowledge on crutches instead of wings. But physicians do not divide into hostile camps on the basic principles of diagnosis.

But when we come to Medicine in the form of a *prescription* science is thrown to the winds. Is the principle of pure science applied to the pursuit of medical knowledge in the field of therapy? Is commercial rivalry unselfish science? Does pure science have three different solutions in therapeutic truth? Can three rambling roads lead to a centre?

We have three main "schools" (sectarian divisions) of medical practice, working on different therapeutic lines, opposed to each other, sustained by rival business interests, not actuated by the aim of pure science to unify knowledge and pursue truth to a single end.

We have medical colleges divided into hostile camps on the subject of therapeutics, although one in the common teaching of anatomy, physiology, diagnosis and other basic branches of medicine that lead up to the prescription.

We have, yes! we are beginning to have "Institutes of Medical Research" (six of them so far in the world) but they are not working on the problem of unified scientific medicine. Not at all. They bear about the same relation to a movement to place the study of medicine on the same plane of pure science with the study of physiology that a campaign poet bears to the steering committee of the Senate. They will never unify the medical knowledge that writes the prescriptions of the world.

Therapeutics "is that branch of medical science which treats of the application of remedies to the cure or alleviation of disease." It is the ultimate aim and thought of all its related branches, and the actions of remedies and the principles of prescribing them should be studied by rules of

research as rigidly scientific as those to which the physiologist and chemist compel themselves to conform.

In such departures from health as call for medical aid the end of therapeutics has no other rightful purpose in science or truth than the determination of the best possible prescription towards restoring the sound state. This is the single end and common purpose. It includes prevention, palliation and cure. It demands unified principles of study and the pursuit of truth *no matter where it leads*. It makes no impossible demands of achievement, and presents few obstacles of greater difficulty than have been overcome in biological and chemical research.

So far as the results of such study may, for many years, fall short of the world's needs of medical knowledge the world will accept them with commendations and hope. But to witness our beloved "Science of Medicine" (in therapeutics) drifting through years of unscientific commercialism, inspired by prejudice, made farcical by factions, conducted by the progress of chance, without unified principles or central system of sifting and determining the *materia medica*, with no common striving for a common good, rejecting the example of every genuine seeker of truth in every other domain of modern scientific investigation, and remaining relatively crude, backward and biassed to the verge of discredit—that is a pitiful spectacle to behold. *Yet there it is.*

This state of affairs accounts for the existence of three standards of prescribing, of three treatises on therapeutics so different that a physician taught from one can use neither of the other two and can scarcely use his own, and explains both the great number of different remedies prescribed by different physicians for even a single disease or symptom complex, and the insurmountable difficulty of prescribing a curative drug in any but the very simplest case.

This state of affairs accounts for the slow, century-long evolution of physical remedies to their rightful place in the *materia medica*. It accounts for the habitual failure of the majority of physicians to comprehend the near approach of

the chief physical remedies to the *Vis Medicatrix Naturæ*, and it explains but does not justify the general withholding of nature's own remedies from the large class of invalids in greatest need of them. But to lift the profession from this rut of habit *what influence will suffice and from whence (and when) will it spring?*

Yet high frequency currents are ready *now* to do their allotted work in the hands of every physician who will use them.

THE END.

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BY

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